101

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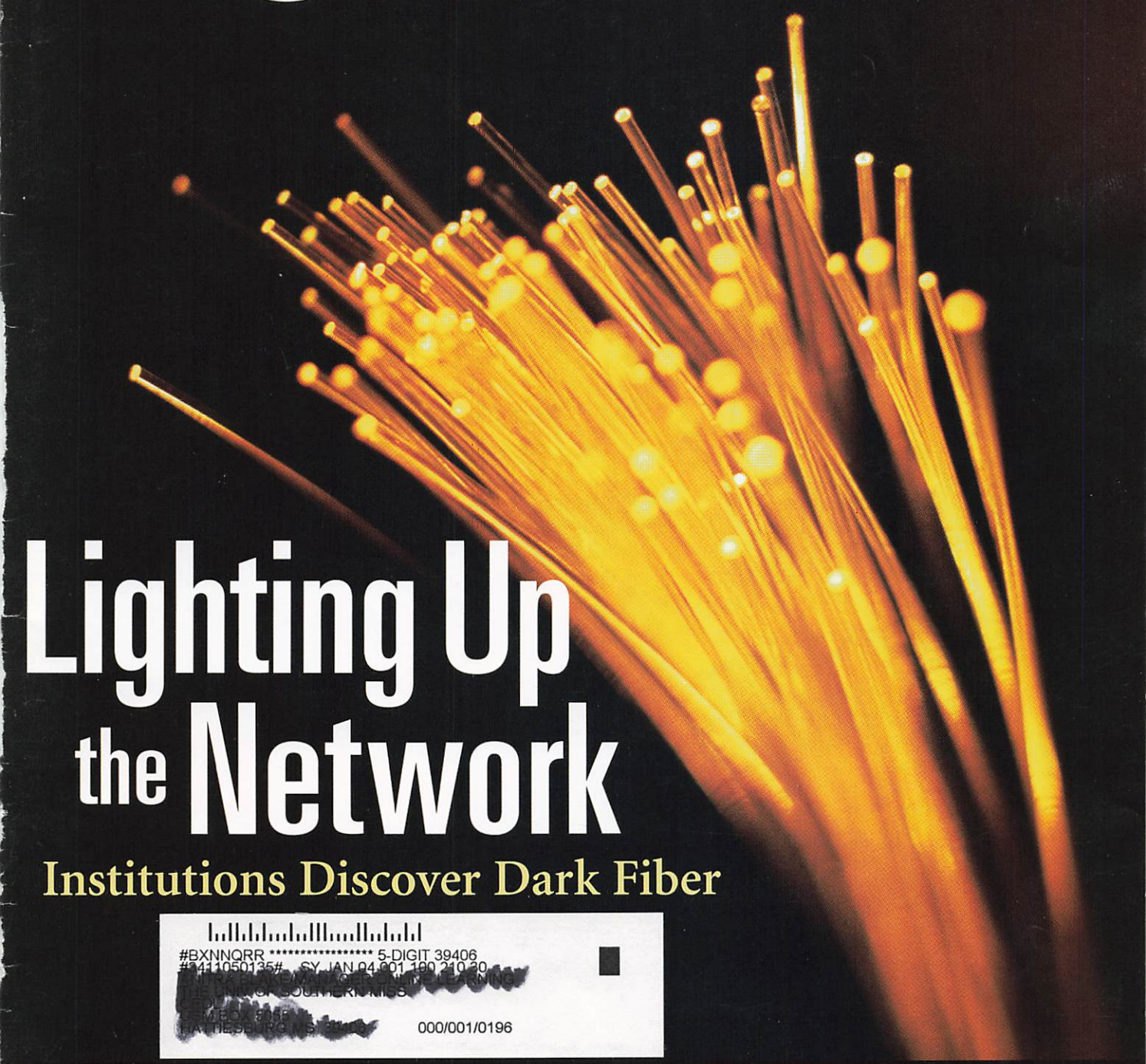

Lighting Up the Network

Institutions Discover Dark Fiber

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INTERNET2 APPLICATIONS • BANDWIDTH SHAPING • NETWORK MANAGEMENT

> **10:45 pm.** To provide more answers to more technology questions, CDW·G account manager Nora Weeks engages in her own form of homework.

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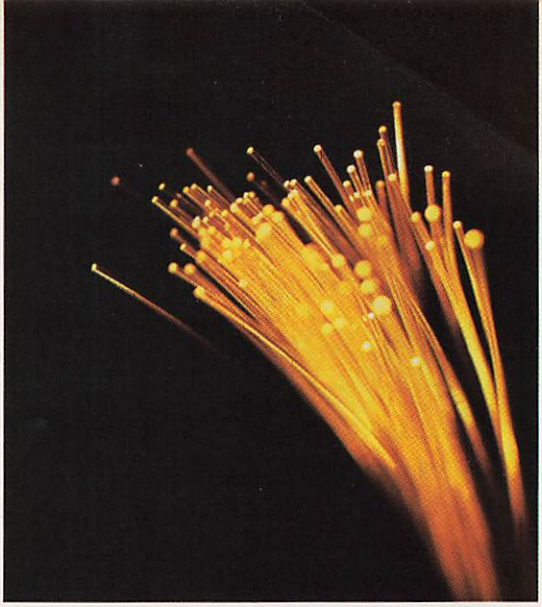

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Cover Photo: Min Roman

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An Interview with Joel Hartman, University of Central Florida
Networks are now central to the workflow and exchange of academic, administrative, and social information for students, faculty, administrators, and staff. Here, a seasoned CIO identifies key issues, trends, and concerns as he watches the exponential growth of his campus network.

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EDITOR'S NOTE

Mary Grush, Editor

Virtually everyone depends on the campus network. Students, faculty, administrators, staff, alumni—who doesn't access the network in the course of their work, study, or basic communications? In an interview on page 8, Joel Hartman, the University of Central Florida's CIO, observes that the campus network is now mission critical to almost all of the business processes of the institution. He compares this to our dependence on the power grid and discusses the challenges of providing safe, secure, reliable network services to a diverse and evolving community.

It's no surprise that there's a growing demand for bandwidth, especially for certain academic and research applications. To build out the network and support higher bandwidth users, network planners are turning to dark fiber. In "Lighting Up the Network" (page 14), Brian Voss explains why institutions and consortia are acquiring dark fiber, and how National LambdaRail and related initiatives can help meet greater bandwidth requirements and extend the range of the campus network.

Internet2 has supported advanced networking in higher education since 1996. In this issue, two articles show different dimensions of how I2 is used. In "The Internet2 Commons" (page 24), four researchers describe how they've used multipoint video conferencing technologies in their collaborative work for the Network for Earthquake Engineering Simulation (NEES), improving communications and fostering community. And "Promoting Internet2 at Teaching Institutions" (page 26), details how Cal Poly-San Luis Obispo offered mini-grants, a class, and expert "champions" to help bring an array of Internet2 applications to teaching faculty and students.

New tools for network management reflect the changing environment of IT in higher education. Our Buyer's Guide (page 36) features tools for security, remote administration, and bandwidth shaping.

You'll note that we have included an "InBox" department in this issue (page 6). We're pleased that we've received a large volume of e-mail in response to recent issues of *Syllabus*, and we would like to hear from you. Whether it's your reflections after reading a *Syllabus* article, a correction, or a new topic you'd like to see covered, please address your e-mail to mgrush@syllabus.com. We'll publish submissions as space allows.

Finally, please see the final Call for Papers for Syllabus2004 on pages 22-23. We've extended the proposal deadline one week to accommodate more submissions in January. Our annual summer conference, July 18-22, will be held in downtown San Francisco, with one day of programming across the bay on the UC-Berkeley campus. There's still time! Follow the simple instructions on page 23 and send your e-mail (to speaking@syllabus.com) by January 12.

Enjoy this issue of *Syllabus*!

Mary Grush

Letters to the editor should be addressed to the editor and sent to 101 First Street, #605, Los Altos, CA 94022, or via electronic mail (mgrush@syllabus.com). We reserve the right to edit all submissions. **News and product information** will be considered for publication. Please send all materials to Paul McCloskey. If you are interested in writing for *Syllabus*, please send a brief description of your article idea along with writing samples to the editor at the above address.

Syllabus
TECHNOLOGY FOR HIGHER EDUCATION

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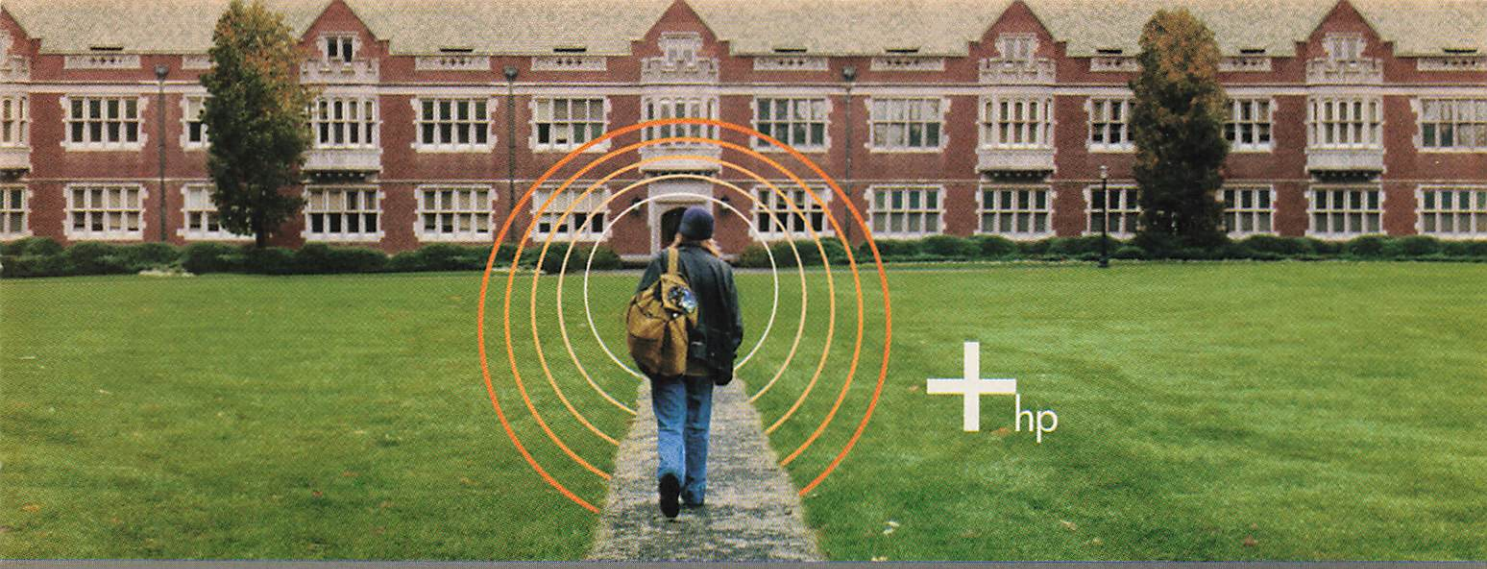

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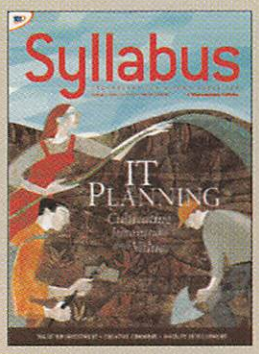
INBOX

Feedback from our *Syllabus* readers



In the November 2003 issue of *Syllabus*, Howard Strauss focused his Reflections column on open source software. Since then, we've received numerous e-mails about the column, a few of which are printed on this page. Many of the letters we received indicated they thought that Howard was taking a stand against open source software and was characterizing the people who write it to be less than competent. But a careful reading of that column will reveal Howard's intended meaning: that there are costs associated with any software, and that one should be aware of all the costs, including staff time, before electing to use open source software in higher education IT environments. We know that Howard has promoted open source software on his own campus as well as in presentations at professional meetings, and he wasn't saying that inexperience is the norm for open source developers.

We'd like to hear your thoughts about this and other *Syllabus* articles. Please send your e-mail directly to the editor: mgrush@syllabus.com.

Open Source

I am writing to respond to the amusing if inaccurate essay by Howard Strauss, "The FREE, 0% APR, Better Sex, No Effort Diet."

The major flaw in his reasoning is his assessment of which people would develop open source software, and why. Let's step away from computers for a minute. Supposing I'm a musician, and for some reason I want a new kind of instrument, or microphone, or amplifier. Building it myself would require both time and expertise, and if I lack either I couldn't do it. Paying someone to build it would require money which I may not have.

Now supposing I got as far as I could and then released my unfinished design under an open source license. My expectation is that there are other people out there who would also want the same sort of tool, and they would each have different contributions to make to the design. Rather than give up a large block of time or money, we each give up an exclusive claim to the resulting design—and we may not get royalties, but we get the tool, which we can use in the lucrative employ of our skills.

That's why so many high-end computer users love open source software. It's by, of, and for the tool-users. People who depend on the tool users' expertise—their employers or clients—also benefit.

But the tool manufacturers won't be driven out of business. "Free software" is only really free to those of us who can parse:

```
./configure
make
su
make install
```

That is, it's free to people who know how to modify source code without harming anything. Everyone else will still need to pay money to get tools geared to their comfort level, so Mr. Strauss can relax.

Mitch Maltenfort
Drexel University
Philadelphia, PA

Mr. Strauss makes some excellent points in his article, "The FREE, 0% APR, Better Sex, No Effort Diet." Clearly a lot of schools try to "save money" by using poor-quality free software when there are better alternatives and hiring students to do important programming tasks when they don't have the necessary skills or experience. But isn't it possible that Mr. Strauss is throwing out the baby with the bathwater? As a full-time professional programmer with a Master's degree in computer science, who happens to develop open source software both at home and occasionally as part of my work, I'm dismayed that *Syllabus* has chosen to print an article that trashes the work that I and many other open source programmers create.

Dominic Mazzoni
minorninth.com

The comments by Howard Strauss concerning open source software were inaccurate and foolish. I have been involved with open source software for over five years now, and I can not see how anyone who has any interest or knowledge in information technology can make those comments.

Mike Perkins
Columbia College
Columbia, MO

Bravo on your recent article http://www.syllabus.com/article.asp?id=8460. Your points are dead on the money and I am totally in your corner.

Johnathan Mohr
Philadelphia University
Philadelphia, PA

Correction

Unicon's telephone number was printed incorrectly in the December 2003 Annual Buyer's Guide. The correct telephone number is (480) 926-2368.

Phillip D. Long

TRENDS

AN INFORMATION RESOURCE OF INTEREST TO EDUCATORS

What's New in 2004 — Redux

BRIEFS

- Fudan University plans to launch one of China's largest English education Internet portals.
- Clemson University is developing a 400-acre automotive research campus, which aims to make South Carolina an automotive industry hub.
- Student Advantage, an electronic media developer for the college demographic, sold CollegeClub.com, a collegiate social portal, to Alloy Inc., a direct marketing firm.
- A team of university astrophysicists are part a team making the first-ever 3D study of the solar maximum to the peak of the sun's 11-year activity cycle.
- UMassOnline, the University of Massachusetts's Web-based learning division, said revenues and enrollments grew 40 percent and 33 percent respectively, in 2003. Revenues were $11 million, up from $7.8 million in 2002, while enrollments reached 13,375.

For these and other news stories, or to subscribe to our eNewsletters, Syllabus News Update, Syllabus IT Trends, visit www.syllabus.com.

Last time I was finishing my look ahead at the technology to watch in '04 and ran out of space. I wanted to touch on trends in battery technology and educational software development. So forthwith, keep an eye on the following. A battery technology emerging in '04, whether early in the year or later, is changing the playing field. The leading contender to add to your independence is the fuel cell battery, which it turns out, is not really a battery at all. A fuel cell is an electrochemical device that combines hydrogen fuel with oxygen to produce electric power, heat, and water. Instead of applying a periodic recharge, as one would with a battery, a continuous supply of oxygen and hydrogen is supplied from the outside.

The rush is to come up with a small, efficient, and economical energy cell that out performs lithium ion batteries, even as the laptops that use them are getting increasingly efficient in their energy consumption. Millennium Cell of Eatontown, New Jersey, has a hydrogen-based fuel cell made from sodium borohydride. Borohydride is the primary ingredient of borax; the natural mineral used for making laundry soap that was made famous by 20 mule-team Borax and sponsor of the Wagon Train.

The source of the original fuel cells was based on methanol to derive the source of the hydrogen. However, the notion of carrying around a highly flammable charged hydrogen container is less than appealing, and probably not possible in the air. On the other hand, common ethanol is transportable and produces energy efficiencies similar to those of the methanol prototypes.

Toshiba and NEC have made commitments to producing fuel cell batteries for laptops. Other manufacturers are ramping up to follow suit. The idea of getting 12 hours of energy for your laptop, and then providing it with a new source of fuel with an injector that takes seconds to transfer the compressed fuel into the depleted cell is compelling. Not carrying the extra weight of secondary batteries is wonderful idea.

Synchronizing the Development Clocks at Multiple Institutions

Developing educational software is hard enough at any one institution. Coordinating development at multiple institutions is more difficult. Having a common development calendar with an agreement to deliver a release that shares a common code base—priceless. Well, not exactly, but it's rare. Enter SAKAI.

SAKAI is a collaborative effort among the University of Michigan, Indiana University, MIT, and Stanford with five main deliverables: an enterprise services-based portal, a complete course management system with sophisticated assessment tools, a research support collaboration system, a workflow engine, and a clear standard for writing future tools that can extend this core set of educational applications.

A key outcome of this effort is the Too Portability Profile. The TPP pulls together four elements: the Open Knowledge Initiative open source interface definitions; the

continued on page 41

Syllabus interviews Joel Hartman, CIO for the University of Central Florida, about issues surrounding the growth of campus networking. Hartman is responsible for library, computing, networking, telecommunications, media services, and distributed learning activities at the university.

CAMPUS NETWORK

A CIO'S PERSPECTIVE

A CONVERSATION WITH JOEL HARTMAN

S: What are the some of the overall trends you're observing in campus networking?

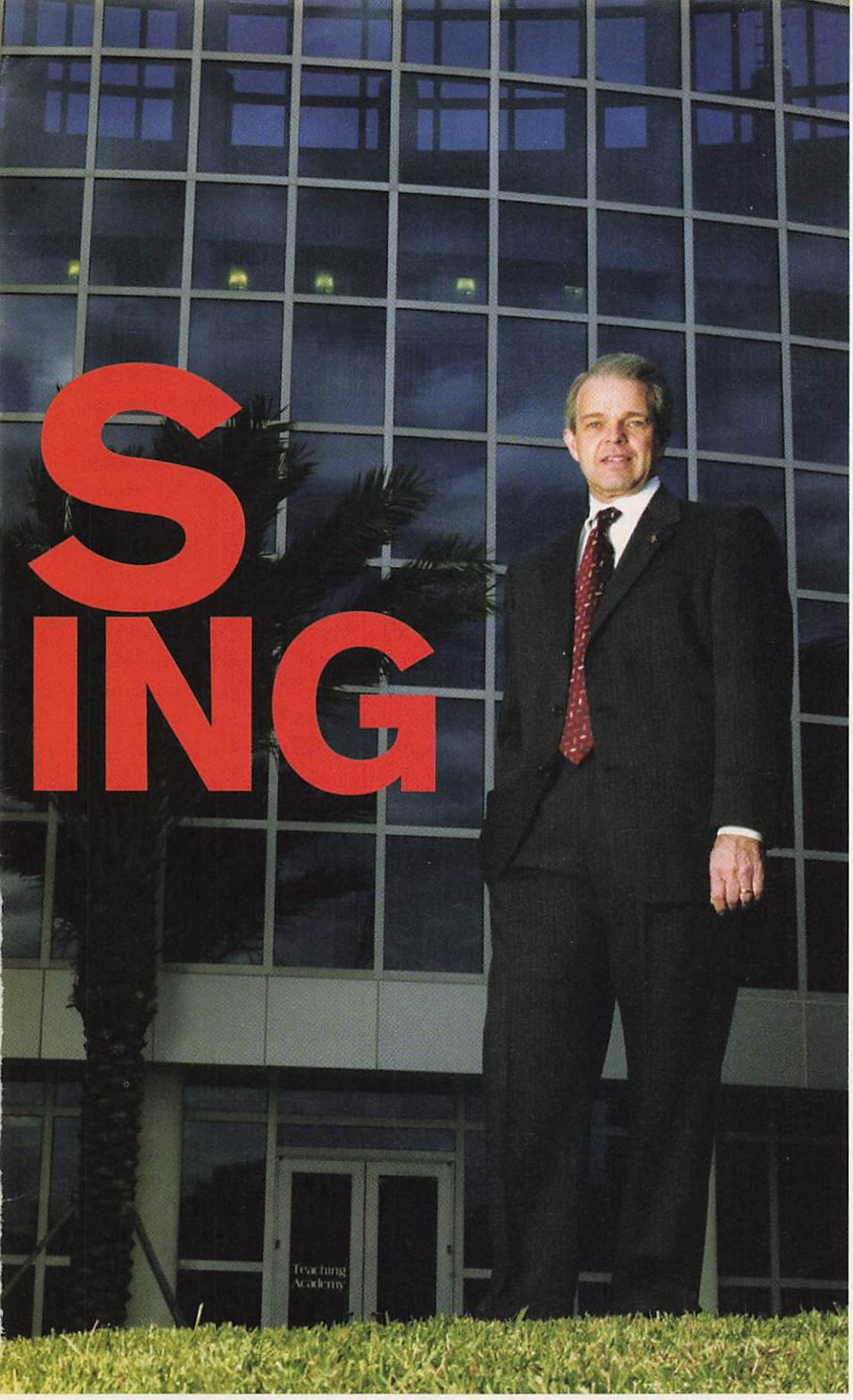
JH: The first thing I'd say is that, over the last decade or so, both in higher education in the business world in general, computer networks have become absolutely central and mission critical to virtually every business process that we have. The good news is that we've wanted to build network-based services, and we've done that. And now that we have them, we find that they impact almost every aspect of the institution and institutional life. We've become increasingly dependent on our network resources—departmental and campus networks, as well as the commodity Internet, Internet2, and other emerging research networks.

To a great extent our reliance on the network is roughly comparable to our dependence on the power grid. The recent blackout in the northeast, I think, has pointed to how much life can change in the event of a power grid outage.

The same can be said for anything that impacts the network. On the one hand, we are seeing growth in the use of our networks. On the other hand, we're now looking very seriously at the kinds of risks, threats, and even routine planning and operations that deal with the reliability and security of those networks. Higher education, as you well know, has been an open environment for the creation and sharing of information, and our networks have been designed to facilitate open access to information. We are confronting the conflict between open, free access, and secure network environments. We are going to have to adjust to change and the new realities of what it takes to keep our networks operating, secure, and robust.

S: Are these changes and the increased dependence on the networks impacting academic and administrative departments in similar ways?

JH: Actually if you think about the multiple dimensions of how computer networks are used, the previous distinctions between administrative and academic uses are really falling by the wayside. There are simply *uses*. Increasingly, users are thinking about the network as an extension of some other device, their desktop PC, their laptop, their PDA, their cell phone, or whatever it might happen to be. And their uses of the network are a continual blend of what we used to call



administrative applications, academic applications, and communication or social applications of computing. The applications themselves—an ERP system or an academic database, or a library database—today are certainly as valuable as they always have been. But the use of our computers as communication devices, which has been enabled by networks, is what has really substantially changed.

S: How would you characterize the new expectations for having access to databases and information?

JH: The model that we are all leading to is *anything, anytime, anywhere.* And that means the ability to get information. The ability to communicate. The ability to conduct business, that is, make transactions. All on a 24/7 or 24/365 basis. And we have moved from a just-in-case to a just-in-time expectation. When I prepare for a meeting, I often find myself looking up information minutes before the meeting starts, as opposed to hours or days before. We've become reliant on, and expectant of, information to be at our fingertips online, and the way we think, the way we work, and the way we interact has changed accordingly.

S: What are some of the challenges right now in campus networking?

JH: Well, on the one hand, there are the things we want to do, some of which include moving into wireless and to new applications. And then there are things that come as challenges or issues to be confronted and managed, which include bandwidth management, the advent of Peer-to-Peer computing, or worms and viruses coming into the network. One might classify all of those into good things or not-so-good things. On the "good things" side are the new and exciting uses of our networks, having to do with the new applications that are becoming network based and the convergence of voice and video into the network domain. Our networks now are not only pipelines for data, but also increasingly for voice and video services.

Another challenge is that the kinds of devices that are expected to have access to the network is growing. It's not just our desktop machines, laptops, servers, and mainframes, but now also hand held PDAs of various kinds, tablet computers, and even security devices and video projectors—all kinds of things are now getting IP addresses and interacting through the network or exchanging information, that several years ago would not have been part of the picture. So that means that the networks are being used for more things and are depended on by more kinds of devices, and more and more those devices are mobile.

Photography by Gary Bogdon

S: What's one of the more difficult issues to confront?

JH: Peer-to-Peer computing. On its surface, it can be a very useful tool. In fact, there are those who predict that if it were done properly and for appropriate purposes, Peer-to-Peer could be a very sound model for certain kinds of applications. Instant messaging and groupware can work very well in a Peer-to-Peer environment. But the reason Peer-to-Peer has gotten to be so controversial is the early advent of programs that were used for sharing copyrighted materials such as music and video files. Plus, the applications that do that tend to be designed to use as much bandwidth as they want—meaning there is no such thing as too much bandwidth with these applications running. Left unmanaged, they can overrun any amount of bandwidth we can possibly purchase.

So, Peer-to-Peer is a phenomenon that has to be managed both in a legal and technical framework. But new, copyright-legal licensed music services are coming on the market that allow institutions to examine other alternatives for students, rather than simply allowing them download music over the Internet. Penn State is one of the first to have licensed such a service.

S: How is Peer-to-Peer playing out at your own institution?

JH: We have, through bandwidth shaping, basically eliminated it as an issue. We can keep the activity to an absolute minimum, and when we know of a particular issue with a certain user, we can deal with it through the normal student judicial process.

S: Your campus has seen tremendous growth in the past years. How has the network kept up?

JH: About ten years ago, in the 1993/1994 academic year, we had 23,500 students. This past fall we had 42,000. Each year we need to construct about 8,000 square feet of classroom space to meet growth needs, and hire about 110-120 faculty. We are still building out the campus and have on our capital planning agenda more than sixty major construction projects, totaling about $600 million dollars of construction yet to go. The staff, when they can laugh about all this, jokingly refer to it as laying track in front of a speeding train.

"We feel we need to begin with a solid, wired foundation and that means to wire all the locations that need network access."

The way we've kept up, in our division of Information Technologies and Resources, is to assemble a group of experts on wiring, telephone, data, multimedia classrooms, and other kinds of resources as a facilities planning group. We meet monthly with the university's facilities planning staff, so that by the time new buildings come on line, they have all the necessary facilities in them, everything from the appropriate voice and data systems, to wiring systems, video systems, and multimedia classrooms. We are able to work with our facilities people very effectively to make sure the new buildings are, in those regards, state-of-the-art.

When a major renovation occurs, we are able to get the appropriate technology into it. We have a continuing project we call the Classroom Improvement Project. A modest name, but it appropriates some amount of money every year to either convert existing classrooms to full multimedia, or to upgrade older classrooms to current standards.

We are approaching the hundred percent level of all campus classrooms equipped with advanced multimedia, computer network connections, touch panels, video display screens, and so on, which operate basically the same all across campus. So an instructor can go into one room, and if they know how to operate that room, they can operate in all.

S: What about growth in online learning at UCF?

JH: I'll just give you a few statistics about our online learning initiative. We've been doing online learning since 1996. This fall we have more than 25,000 of our students enrolled in one or more online courses. We've developed about 2,400 courses. We have ten online degree programs, and are generating somewhere between five and eight of the university's total student credit hours through Web-based learning. It's just one more area where students are using the network heavily for instruction. And to a great extent, what we and many other institutions are finding is that the network itself is taking on the characteristics of what the mainframe used to be as the source of all computing resources. Today, the network is the key component.

S: Could you talk a bit about the strategic role of wireless for your campus?

JH: We feel we need to begin with a solid, wired foundation and that means to wire all the locations that need network access. But it turns out that those locations are typically where people sit to work—their desks, their labs, their classroom seats. What that leaves out is every place where there is not a chair, which is a lot of places. And so what the wireless overlay intends to do, is to provide access literally anywhere in the university environment.

We put wireless in the coffee shop. We put it in the library. We put it in the student union. We put it in the patio *behind* the student union. Certainly the classrooms have it. The public areas of residence halls have it, and common places of that kind. We recognize the fact that a wired infrastructure will, for the foreseeable future, provide higher bandwidth than a wireless infrastructure can.

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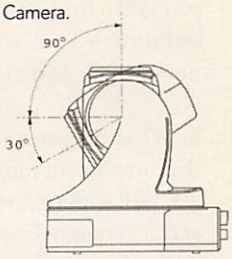

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But, the wireless infrastructure provides something the wired cannot, which is nomadic access to information. It follows you wherever you go. The wireless overlay is intending to provide, literally, an anywhere, any time access to information. We do it in such a way that the user can roam throughout the entire campus and have essentially continuous access to the wireless infrastructure.

S: Do you think it is a reasonable goal for most campuses to have ubiquitous wireless?
JH: Well, that's an individual campus situation. I have attended a number of conferences where that particular issue was under discussion. And the sense of it seems to be that, like student expectations of networking, student expectations of wireless are becoming universal. And the campuses that provide it will fulfill those expectations. The campuses that do not will experience a gap between students' expectations and the resources provided. Where that happens, you will probably find students attempting to build their own wireless implementations, which then may become problems.

S: What do you think about hot spots that branch out into the community?
JH: Well, I think that's really a good idea and it certainly is evidence of the popularity of wireless in general. The problem with the hot spots is that there are so many vendors that to use the hot spots, depending on your travels, you may need to have multiple subscriptions to multiple providers. That currently limits the effectiveness of the hot spot phenomenon. There are signs that the vendors are going to begin working together like the cell companies did, to provide roaming agreements. When that occurs, then one subscription should be sufficient to provide the kind of roaming with wireless computing that you've got with wireless cell phones. Then that service will be much more valuable and practical.

S: What are you doing with VoIP?
JH: We are beginning to deploy voice over IP as a niche application, as opposed to a general replacement for our campus telephone system. We see VoIP as a solution in specific cases. For example, we just built a major new cluster of buildings for our hospitality school. They will be the first all voice over IP installation. We also are using VoIP at other selected locations. But our main telephone system is a modern, though otherwise traditional, PBX architecture that will continue to grow for the next few years. Then we'll reassess VoIP.

"The idea of convergence, where voice, video, and data come together in a single infrastructure, is a very attractive notion."

Part of my own personal concern about VoIP as a total solution is the question of it riding the same infrastructure that we are all the time defending against threats such as denial of service attacks and so on. The idea of convergence, where voice, video, and data come together in a single infrastructure, is a very attractive notion. But it remains to be seen whether we could provide as reliable an infrastructure under the VoIP service as users have become accustomed to.

The issue is not, "Does it work?" The issue is, "Is it as robust and reliable as the voice network has been in the past?"

S: Right. And then you have the security issues as well as your concerns about reliability.
JH: If it were not for security concerns, it would be a much easier thing to agree to. Plus, there are cost issues. And depending on the VoIP architecture and the traditional telephone architecture available, there are some cases where VoIP may be the costlier of the two solutions. That tends to vary on a case-by-case basis, but it's certainly one of the factors one has to consider.

S: What types of new research applications are you seeing on your campus network?
JH: Research-based applications tend to be highly variable. But they involve either access to remote devices at high speed, movement of large data sets, or collaboration such as using caves, immersadesks, and things of that kind—or simply H.323 video conferencing. The growth in that set of applications is enormous. In fact, you now hear people referring to e-science, meaning the impact of computing, advanced computing, and networking on many branches of science where there are new computer-based branches of the former fields. They use simulations, computer modeling, computer data sharing, and visualizations as ways of advancing the science.

So those are simply now gearing up to require more and more computing power and bandwidth to interconnect researchers among institutions, particularly as collaboration expands. And so, research computing is one area that is emerging as one of the more exciting arenas for computing. An example you're well aware of is Internet2.

S: What initiatives exist in higher education that may help promote research-based applications?
JH: Right now on the national scene is National LambdaRail (NLR), which is a new multi-ten gigabit research network environment. And some states, including Florida, have a state component of that network.

For Florida LambdaRail, we're building out a ten gigabit infrastructure and then, of course, when that comes to our doorstep, we'll need to upgrade our campus networks in whole or in part, to ten gigabit, to accommodate these new kinds of science and collaborations that

are developing. And like Internet2, this was seen as reinventing the commodity Internet except with modern technology and higher expectations, which it has done. These new fiber based initiatives, like National LambdaRail, will do it yet again at another order of magnitude higher performance.

And what has tended to happen is, is those kinds of resources and expectations will trickle down and become available to other kinds of uses beyond research over time—simply increasing the opportunities for all kinds of network access to grow in their use of bandwidth.

S: Would you say that's happened with Internet2, the trickle down effect?
JH: Yes it has. In fact, in most campus networks, because the traffic between Internet2 locations is independent of the kind of use, users are communicating over Internet2 all the time, for both research and non-research purposes with almost no second thought to it. And the kinds of technologies, IPV6, IP security middleware, quality of service (QoS), and so on, that have become the focus of Internet2 development, have now worked their way into the products and services that we use for all of our networking. And today, those issues, quality of service, bandwidth shaping, and so on, are now part of the commodity Internet arsenal as well. Of course the problem with the commodity Internet is that the bandwidth is less predictable. But the technology is certainly moving forward.

S: What kinds of directions are you watching for in the future for campus networking?
JH: If you think about the directions in which the network phenomenon is moving, it includes the following kinds of things. The first is that people are using networking to do more things. The convergence notion of voice and video is an example. The second is that they are doing those things in more places. So the issue of both wired and wireless access comes to play. And they are doing more of it, or doing it in ways that demands more bandwidth, meaning that the totality of our needs today requires increasing the size of our Internet connections. And we already have Internet2 and Florida and National LambdaRail-size pipes to support the emerging applications that are coming down the road.

And we have needs for people to have access off of our campuses, which is stimulating a demand for broadband in the home, wired apartment complexes, and connections between places where large amounts of traffic flow. We have connections to our regional campuses in different cities, that allow the students there to access our services over our own network. So essentially, it's spreading out to touch more users in more places with more applications.

And the needs then are for increasing bandwidth and reliability, and we therefore need better tools to manage all of that on a day-to-day basis, both in terms of the network as a resource, and to both monitor its characteristics to make sure it's running properly and to defend it against internal and external threats. It's getting harder with all of those things, because they tend to be additive.

S: Do you find that the networking infrastructure is affecting the brick and mortar in some way, perhaps making it possible to build more flexible designs for learning spaces?
JH: There are different answers that I would give you to that question. One of which is that we are designing our brick and mortal facilities differently, around technologies like networking. A second is, that we have a potential opportunity to build less brick and mortar by virtue of use of the Web. An example would be the 7,200 students that we have taking fully online courses at UCF.

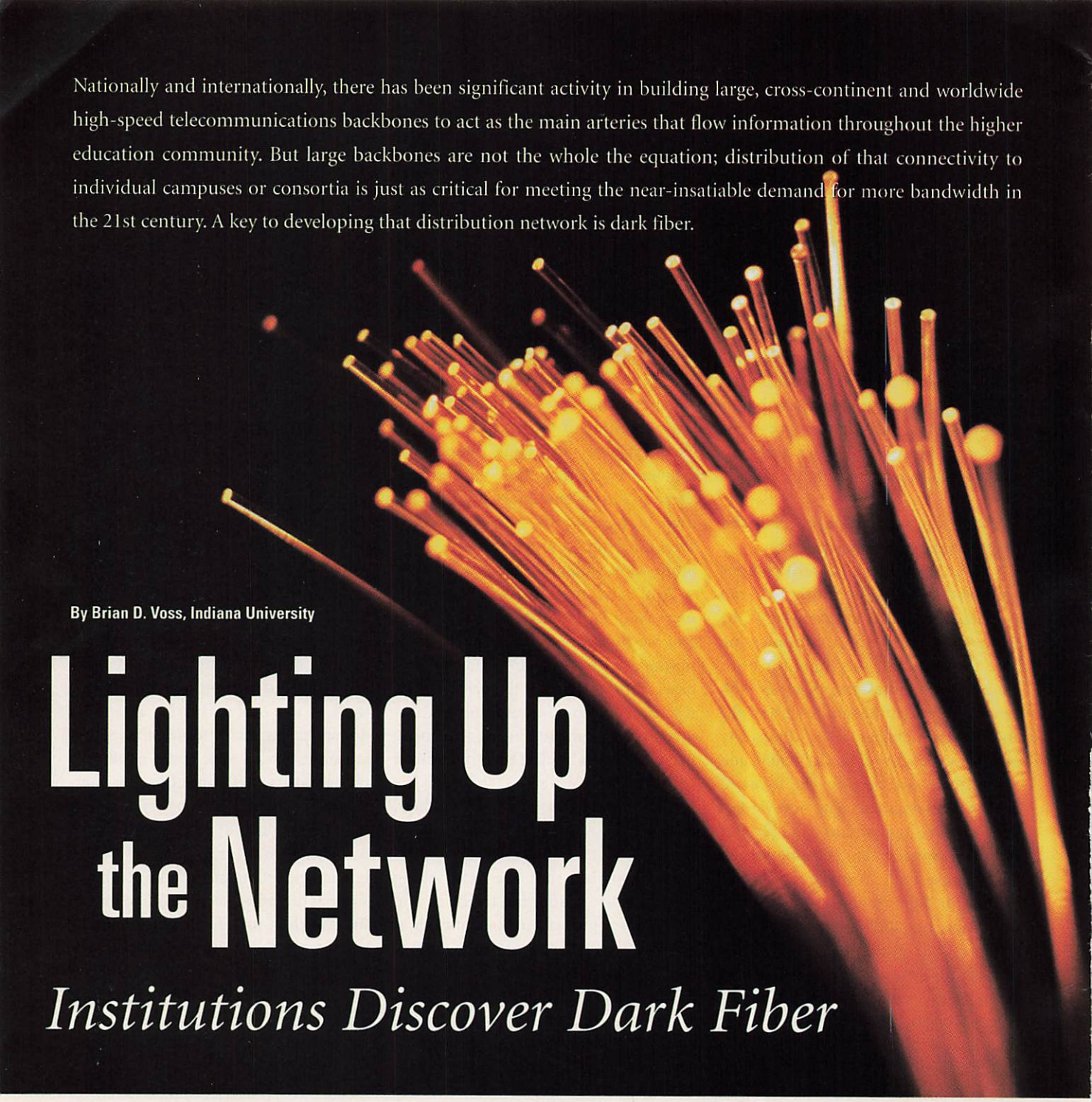
If those students were actually here on campus in classroom seats taking those same courses, we would need more seats. And so the fact that the students are online has eliminated at least the pressure to build that many more classroom seats for them, and there is a direct savings that results from that. Now it turns out there has been no specific decision that says "Don't build this, put them online instead." But the fact that the online program is growing so rapidly has taken some pressure off the need to expand.

We have the opportunity perhaps to avoid some construction because students are able to access resources outside of our brick and mortar buildings. That includes libraries, labs, and classrooms. But I would say that we really haven't cancelled any building projects as a result. So the actual impact is one of avoided costs, not cancelled projects.

S: You've talked about a lot of changes today, regarding campus networking. Is the amount of change we've been seeing going to continue?
JH: I would say is the things we have talked about are all, in their own way, evolutionary. We continue to move down the path toward greater use of networks, more dependence on networks, more ways to use our networks, and more devices having access to networks. There are authors who write about networked refrigerators, networked homes, networked clothing, that is network devices down to the level or our wristwatch and our shoes and our appliances in our homes, and all manner of things. This all suggests that what we have seen to date, in the growth of use of networking is just a precursor to things to come.

S: If there was one thing that you could wave a magic wand and influence right now, in the world of networking on campus, what would that be?
JH: If I could have anything I wanted? If I could have anything I wanted in networking, I would have infinite free bandwidth and the total elimination of viruses and worms. In other words, I would have infinite free availability of bandwidth and no security or technical risks. Networking and the management of campus networks is becoming both increasingly complex and taking on increasing risk. Okay, while we may never quite get there, it's worth working towards. But it is also delivering increased benefit.

Nationally and internationally, there has been significant activity in building large, cross-continent and worldwide high-speed telecommunications backbones to act as the main arteries that flow information throughout the higher education community. But large backbones are not the whole the equation; distribution of that connectivity to individual campuses or consortia is just as critical for meeting the near-insatiable demand for more bandwidth in the 21st century. A key to developing that distribution network is dark fiber.



By Brian D. Voss, Indiana University

Lighting Up the Network

Institutions Discover Dark Fiber

Two terms making their way around higher education information technology discussions these days are *bandwidth* and *dark fiber*. *Bandwidth* is a term that meant very little to anyone outside of a telecommunications function in colleges and universities a decade ago. Today, bandwidth is the key ingredient to the advancement of nearly every initiative and service within higher education institutions. Bandwidth is the coin of the realm for research, teaching and learning, distance education, and service to campus residents. Bandwidth is the gas that makes information technology (and the information economy) go. Bandwidth is everything.

Dark fiber is how your institution can get bandwidth—in quantities needed to serve higher education with high-speed telecommunications at costs that you can manage in these tough economic times.

To understand dark fiber, it is helpful to learn another bit of telecom terminology: *lit service*. This is, in the parlance, the opposite of dark fiber. Lit service is a connection that you purchase from a telecommunications provider (e.g., SBC, AT&T, Qwest, or Level3 Communications). With a lit service, you are buying a specified amount of bandwidth, usually in terms of speed/capacity—such as OC-3, which

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Dark Fiber Initiatives

I-Light: Expanding Access in Indiana

To meet the steadily increasing demand for network capacity supporting teaching and learning, research, and residents of their campuses, Indiana University and Purdue University collaborated to create I-Light, a university-owned fiber optic network linking the State's three core campuses in Bloomington, Indianapolis, and West Lafayette to each other, and to the Internet, Internet2, and advanced research networks beyond.

Funded in 1999 by a state appropriation of $5 million and completed in 2001, I-Light has yielded a 20-fold increase in inter-campus connectivity and a five-fold increase in the campuses' Internet bandwidth without increasing operating costs. It supports significant high-end collaborative applications and faculty research programs in such areas as grid computing, human genomics, remote instrumentation, and visualization.

I-Light has enabled the development of a distributed three campus supercomputing "grid" with broad computation, storage, and data resources called IP-grid, which was selected in September 2003 by the National Science Foundation as one of three new sites added to the national TeraGrid Facility. In addition to research applications and Internet connectivity, I-Light also supports inter-campus voice communications, e-mail, and video conferencing.

I-WIRE: Connecting Researchers in Illinois

I-WIRE represents a new type of emerging advanced infrastructure. It is an innovative distributed facility, much more powerful than those found on traditional national research networks (NRNs). Unlike NRNs, I-WIRE is designed specifically for, and dedicated to, a community of researchers, for investigation and experimentation not possible on traditional routed networks.

I-WIRE is a dark fiber-based communications infrastructure in Illinois, which interconnects research facilities at multiple sites: Argonne National Laboratory, the University of Illinois (Chicago and Urbana campuses, including the National Center for Supercomputing Applications and the Electronic Visualization Laboratory), the University of Chicago, Illinois Institute of Technology, Northwestern University, the Illinois Century Network, and collocation facilities. I-WIRE provides point-to-point Layer 1 data transport services based on Dense Wave Division Multiplexing, enabling each organization to have at least one 2.5Gbps optical channel. Projects using I-WIRE include the TeraGrid project, OptIPuter, and the Distributed Optical Testbed.

CENIC's CalREN: A Statewide Network Infrastructure for California

January 2003 saw the deployment of the nation's first multi-tiered, statewide optical network, comprised of 1,100 fiber miles and long-haul equipment supporting multiple 10 Gigabit per second (Gbps) Ethernet connections as well as many separate links at 1Gbps or greater. The new optical infrastructure became fully operational with the California State University system; the community colleges and the K-12 county nodes expect to transition to the new backbone by the end of the first quarter of 2004.

Educational networks in California, and nationwide, have typically depended on leasing circuits from telephone or cable companies. Utilizing leased circuits requires long-term planning to allow for the development of detailed specifications, bidding, and then building of the network, making what should be a simple upgrade time consuming. By making the transition to an "owned" fiber optic infrastructure with scalable network components, additional bandwidth may be added incrementally without the need to redesign the underlying technology.

represents how much data can be sent across the connection (in the case of an OC-3, ~155 million bits per second). You usually sign contracts for this service—anywhere from one-year to three years in length—where the provider guarantees to give you the service for a specified monthly cost. With a lit service, the provider handles all the elements between your campus core router and the core router at the destination (e.g., the Internet, Internet2, or another institution). You simply hook-up and use it, and what's between you and where you are connecting is not really your concern. But that is a canard, because it *is* your concern...you are paying for it. You are paying the provider (and likely paying more than you would if you controlled the "what's between" yourself).

Dark fiber is a fiber optic connection path that has not been lit. In telecom terms, dark fiber is something you acquire, either through buying unused fiber that is already in place, underground or aerial (which means attached to telephone poles) or that you contract to have installed, underground or aerial. You own the path (or route), and you are responsible for the integrity of that path, and for acquiring equipment to light the fiber and make it actually carry your information. You own it either outright, or via another term: *Indefeasible Right to Use* (or IRU). An IRU is simply a lease of the fiber, meaning it is yours to use (and to be responsible for) for a set period of time, usually 20 years, though shorter IRUs down to five-year contracts can be found.

Need a non-technical analogy? Consider water. Your home has a connection to a nearby water facility. The water company paid for the pipes to get water to your neighborhood and then to your house (though you likely paid a one-time connection fee); and they own those pipes (infrastructure). You pay the water company to provide water to your house, for which they charge you by how much you use (by the gallon). That is the 'lit service'

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model. But if you dig a well, and tap into an aquifer and then pump your own water to your house, you no longer pay by the gallon—but you do pay for the well, the pump, the purifier, and so on. And of course, in the 'well' model, if something goes wrong you can't just call one number and get it handled. You are responsible for figuring out what's wrong and getting it fixed (though there are companies in both this analogy and in the telecom reality that will do this for you too). The water analogy is a little over-simplified, because while you can draw aquifer water for free, you can't draw Internet drainage (your connection to the Internet) for free. But it's close enough to get you on the track to understanding what's going on.

The Demands for Bandwidth

Colleges and universities have seen an explosion in their need for bandwidth in the past five years. Residential institutions have been wrestling with the need to increase their bandwidth to the Internet to deal with the Peer-to-Peer issue (i.e., Napster, KazAa, and others). While control of these applications has been one approach, in reality while you can cage the beast, it remains a beast that must be fed. Most institutions have combined controls with expansion in their connectivity. But while these recreational uses grab the headlines, there has been a steady increase in other, more mission-centric needs for bandwidth.

Research in particular is driving the need for additional bandwidth. Research has always been a driver of institutional function—but it is perhaps more so today, as dwindling budgets have focused institutional direction on bringing in more research funding to drive overall institutional activities. As well, advances in the tools used for teaching and learning have also driven an increase in demand beyond research (and for institutions that don't do research). More courses are online today, whether they are distance education focused or a part of on-campus course management systems. And the tools used by these systems in support of the vital teaching and learning function have advanced—more graphical data, more multimedia (audio/video), more collaboration (video conferencing), and greater access to digitized library data. Campuses today are no longer isolated islands of information; they are plugged into a growing grid of information and resources beyond the boundaries of the campus, on the Internet. And many institutions are becoming net exporters of information, feeding more information out to the scholarly world than they draw in.

"Dark fiber has become a way for institutions to expand their domain of control..."

With these increases in demand for bandwidth comes the need to get control over this new piece of the infrastructure: the connections off our campuses. In the lit service model, institutions pay a provider by the bit (in simplest terms). The more you need, the more you buy, and the more you need to spend. While there are quantity discounts to be sure, the explosion of need has rendered the attempts to stay at a constant cost-state futile. Expansion far outpaces the volume discounts of buying bigger lit service 'pipes.'

A good analogy is to look at how your institution deals with other forms of infrastructure. Does your institution have its own telephone system? If so, it is likely that it was more cost effective to have control over the infrastructure rather than paying (per phone) to a provider. Does your institution have its own power plant? If so, it is likely that it was more cost effective to generate and distribute all (or a portion) of the institution's need for electricity than to pay by the kilowatt to the local power company. Does your institution own its own land and buildings? If so, it is likely that it was more cost effective to do so, rather than lease space from a provider. Telecommunications infrastructure—dark fiber—is a similar infrastructure resource, to be considered as a 'buy' or 'build' decision point.

Dark fiber has become a way for institutions to get control of a new, vital resource—bandwidth. Bandwidth to feed its needs for teaching and learning, bandwidth to feed its needs for advancing research, and bandwidth to feed its need to be a provider for its campus community of scholars and residents.

Connecting the Campus

Colleges and universities long ago made the decision to pay close attention to their on-campus networks. This included installing fiber optic backbones, advanced communications wiring to each desk and dorm room, and acquiring the equipment to establish a campus network. However, now the equation has shifted, because the balance of flow has shifted off campus (i.e., not just between users and buildings on campus) to connections to the Internet world beyond. Dark fiber becomes a way of expanding the campus network to the point where it connects to the national and global Internet(s) and to other collaborating, regional institutions. In the latter case, this could be connected within a multi-campus institution. And it could also be to connect to neighboring campuses within a given state or region of the country.

Dark fiber removes your institution's dependence upon the telecommunications providers, who bring a vast array of complicating issues from tariff to competition (or lack thereof) to the institution. There is a national information superhighway in place: this is the Internet (commodity

Internet for the faithful, the place where all those dotcoms are), and the advanced higher education research Internet community (Internet2, National LambdaRail, global advanced network peering points, and others).

Institutions or consortiums of institutions have benefited from dark fiber—to build their own on-ramps to the information superhighway. Dark fiber is a way for institutions to expand their domain of control, to the point where the campus network more easily connects to the rest of the world. There will always be charges associated with accessing the rest of the world—because they have an infrastructure that needs to be supported. But one more element is put under the control of the institutions: the path from their campus to the points of connection to the rest of the world—GigaPoPs.

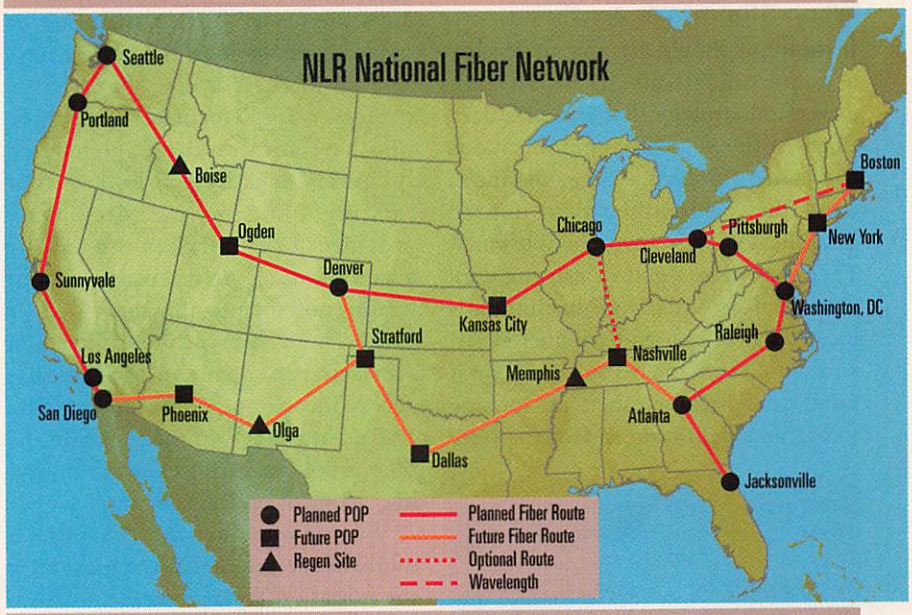
National LambdaRail: Lighting the Future

In May 2003, a consortium of U.S. research universities and private sector technology companies formed a non-profit corporation, **National LambdaRail, Inc.** (NLR). NLR is dedicated to building a national scale infrastructure for research and experimentation in networking technologies and applications. NLR is the largest higher education-owned and managed optical networking and research facility in the world, with approximately 10,000 route miles of dark fiber and four 10 Gbps light waves or lambdas provisioned at the outset.

NLR is not a single network; rather it is a unique and rich set of facilities, capabilities, and services being built to support a set of multiple, distinct, experimental, and production networks for the U.S. research community. On NLR, these various networks will exist side-by-side in the same fiber optic cable pair but will be operationally independent of each other.

NLR is the first national infrastructure that will allow researchers to dedicate wavelengths to a set of different problems, giving the community the freedom and flexibility to stress the network in order to identify solutions and applications.

On November 18, 2003, National LambdaRail announced that it successfully lit the first path on the national footprint between Chicago's StarLight facility and the Pittsburgh Supercomputing Center (from the University of Pittsburgh and Carnegie Mellon University). NLR is currently working on the Seattle to Portland, Oregon path as well as a path between Portland and Sunnyvale, Calif.



For more information, visit www.nationallambdarail.org.

Dark Fiber and You

You may be asking yourself, "*What should my institution's dark fiber strategy be?*" This varies by institution. There is no one-size-fits-all dark fiber strategy. Variables include the size of the institution, its focus (research, teaching, service, etc.), its relation to other institutions in its state or region, and most importantly its location.

These are varying facets of building a custom strategy for your institution. The overriding conceptual strategy, however, is consistent—to get control of the infrastructure resources that best position your institution to succeed in the 21st century.

Large, research institutions should look for the nearest significant point of access to the Internet(s). They should then look to buy or build dark fiber infrastructure from their campuses to these access points. From these major GigaPoPs, they can then work strategies to connect themselves into the commodity Internet and advanced Internet. With regard to the former, the larger and more diverse GigaPoP, and the greater the competition for cost-intensive services (like commodity Internet connectivity). Competition alone means you can bid out your Internet drainage demands and look to acquire Internet drainage at substantially reduced rates.

Smaller institutions should look for partners in their geographic areas to build a Web of dark fiber, connecting several institutions to each other and then to these significant points of access to the Internet(s). Combinations include finding a large partner to lead the effort. The advantage here is in pooling needs and budgets, to get more volume (which leads to better pricing on top of the competition aspect mentioned above). Building a consortium also helps spread the costs of these solutions across more entities.

The State of Indiana is one example of how these strategies were deployed. The I-Light Network allowed two major institutions, constituted from three major core campuses, to build infrastructure that essentially combined their campuses onto one large campus network, and then through connections to the state's existing higher education network, bring in its demand to pool for bidding for service. The results have been astounding. The I-Light consortium now gets commodity Internet service for about one-fifth of what it used to pay (per million bits per second capacity), due to the competition between providers facilitated by being in their main points of presence, and through the pooling of need which established a very large (more than 1.5 billion bits per second) jewel for these providers to bid upon.

When Should We Act?

Institutions should act now to develop a communications infrastructure expansion strategy that includes dark fiber. In the 90s, telecommunications companies installed a large amount of dark fiber, which then went unused once the dotcom/telecom bubble burst. There has been a glut of existing dark fiber in place, and if your institution is located where unused dark fiber exists, you should seek to lay your hands on it now. Why? Because others are looking to buy low, right now! In fact, there are dark fiber initiatives at varying points of development or deployment in nearly 20 states today. And as the economy has started to re-ignite, this unused commodity will disappear soon enough.

As well, national initiatives such as National LambdaRail are driving the broader research component. Advances at the national level are linked closely to the development of regional optical networks (RONs); in fact, they are co-motivators. Dark fiber is an enabler of the national and regional initiatives. In this regard, Internet2 has established the National Research and Education Fiber Company (FiberCo) to support regional fiber optical networking initiatives dedicated to research and higher education.

Funding a Dark Fiber Strategy

Funding strategies will vary, depending upon the dark fiber strategy selected to meet the needs of the institution or consortium, the local market for dark fiber, and the timing when such a strategy is implemented. What those who have successfully implemented such networks have found, is that existing budgets that previously provided for lit services can usually accommodate the ongoing costs of lighting and maintaining the dark fiber plant. These costs include co-location (costs to rent space in the Internet access locations), route monitoring and maintenance (to help ensure the fiber is not cut during excavation), and life cycling of optical hardware.

What is often needed, though, is a source of one-time funding to provide for the initial outlay of capital needed to acquire (or install) the dark fiber, whether this be from special state appropriations (as was the case in Indiana), from grant funding, or from other sources of one-time-only capital. Of course, depending upon the current budget costs for lit services, bonding (payback of a loan for construction) is possible. All of this will vary by the specific situation.

But in the end, experience of the successful has proven that the investment, regardless the source, has been a wise one. Getting control of the communications infrastructure means campuses can ride the hardware curve and deploy more advanced hardware capable of driving higher communication speeds (i.e., more bandwidth) as they become affordable. This means that institutions can grow their bandwidth, and do so in a fairly cost-neutral manner. And in so doing, keep pace with this important facet of the continuing evolution of information technology in higher education.

Making the decision to develop a dark fiber strategy is the important first step. Building that strategy will be complex, and building it well will be critical to its ultimate success. There are many questions to be answered—build versus buy, length of IRU, where to get connectivity to the Internet(s), and how or if to form consortiums. But if you make the decision now to start such a process, you will be able to stand on the shoulders of those who have gone before you, and learn from what they did right, and what they want to do differently. There are many places to learn, and many places to get help. The Internet2 community via its many initiatives (including FiberCo) as well as National LambdaRail can provide advice and guidance on the entire scope of the issue, and help you make contact with your colleagues around the country already engaged in dark fiber networking initiatives. But the first step is to make the decision to incorporate a dark fiber strategy into your overall campus strategic plan.

RESOURCES

CENIC (Corporation for Education Network Initiatives in California)
www.cenic.org

Internet2
www.internet2.edu

I-WIRE (Illinois Wired/Wireless Infrastructure for Research and Education)
www.i-wire.org

National LambdaRail
www.nationallambdarail.org

The National Research and Education Fiber Company (FiberCo)
www.fiberco.org

National Science Foundation (NSF)
www.nsf.gov

Brian D. Voss (bvoss@indiana.edu) *is the associate vice president for telecommunications in the Office of the Vice President for Information Technology & CIO at Indiana University. He had overall responsibility for the implementation of I-Light, and he represents IU in national and international high-performance, advanced networking initiatives including National LambdaRail, Internet2, and TransPAC, and has oversight of IU's Global Network Operations Center.*

Puzzled by CMS?

CMS Review

Syllabus

Wednesday, October 15, 2003

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By Frank Tansey

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CASE STUDY
- Supporting CMS Users at Drexel University

By Jan Duros

TECH NOTES
- Help in Selecting a Course Management System

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Viewpoint

A Challenge for Any CMS

by Frank Tansey

The installation and maintenance of a course management system is a challenge in most situations. Campus and organizations installing a CMS must add to their existing infrastructure and then address the issues of obtaining and maintaining content, as well as addressing support and technical services.

As difficult as it might be to install and maintain a campus-based CMS, imagine the issues that must be addressed to create a technical infrastructure in areas where none now exists. Then add a critical need to introduce online learning concepts to a population with limited access to personal computers. Finally, and perhaps most important, provide content to address critical societal needs.

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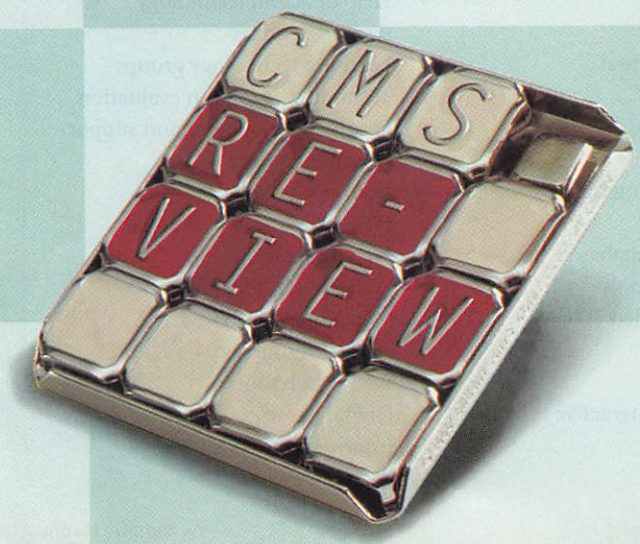

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- **Syllabus2004 will feature informative sessions relevant to technology** for higher education. College and university IT directors and their staff, administrators, instructional technologists, faculty, and others involved in implementing or using technology will want to participate.

  The five-day event will incorporate a range of session types, from in-depth skill development workshops to highly strategic panel discussions and visionary keynotes. Breakout sessions will be offered in five timely conference tracks, and poster sessions will provide an opportunity for face-to-face interaction.

  Deadline extension: The proposal deadline has been extended to January 12, 2004, with priority consideration to proposals received by the orginal due date of January 5.

CONFERENCE CONTENT - TRACKS

In five conference tracks, we examine the central themes and key technologies that have become increasingly critical to informed decision makers and faculty in higher education. Some overlap among the tracks is natural, so feel free to choose one or two tracks into which your proposal will most likely fit.

TRACK 1 - NEW TECHNOLOGIES AND TRENDS

From handheld computers to tablet PCs, ePortfolios, and new high-tech tools for instruction, this track samples the new and emerging technologies and applications that are sure to make a difference in the development and delivery of education.

- High-tech tools for instruction
- ePortfolios
- Tablet PCs
- Handheld devices and PDAs
- Wireless instruction
- New publishing technologies
- Smart buildings and classrooms
- Collaboration technologies
- Trends in personal computing
- Voice recognition
- Mobile computing
- Advanced networking applications

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TRACK 2 - INTERACTIVE MEDIA

With today's interactive media, educators can employ new strategies to support teaching and collaborative learning. Streaming technologies, Web casting, and interactive Web sites are being leveraged for efficient and effective content delivery. This track examines how interactive technologies are being used in the classroom, the lab, and for distance education, and highlights the enabling technologies and standards that help make it all possible.

- Simulations and virtual reality applications
- Web design
- Interactive labs
- Human-computer interface
- XML in education
- Web-based image databases
- Web development tools
- High-end digital video
- Streaming media
- Virtual laboratories
- Visualization and interactive 3D modeling

TRACK 3 - IT IMPLEMENTATION AND SUPPORT

Successful implementations of technology include evaluation and support strategies, along with planning for integration with enterprise systems. This track shows what institutions are doing to support faculty development, evaluate technology programs, provide help desk services, and offer resources for technology integration.

- Help desk and technology support services
- Learning technology groups
- Technology program evaluation
- Faculty development and support
- Learning objects and open resources
- Standards and open source
- Web integration
- Web services technologies
- Managing Web-based content resources
- Web search tools
- Digital libraries
- Information repositories and data exchange

TRACK 4 - STRATEGIC PLANNING/ ADMINISTRATIVE ISSUES

Strategic planning may involve a myriad of challenges, from infrastructure issues, to accreditation of distance learning programs, to section 508 compliance. Concerns may include how to determine return on technology investment, or how to plan for current and future waves of technology, portals, and learning management systems.

- Technology infrastructure and IT planning
- Student administration systems
- Online student services
- Course management systems/learning management systems
- Accreditation of distance learning programs
- Accessible information technology
- Content management systems
- Campus portals
- Faculty support and rewards
- eCommerce
- Security for campus environments
- Intellectual property issues
- Globalization of .edu: policies and practices

TRACK 5 - TEACHING WITH TECHNOLOGY

This track offers a faculty view of the intersection of technology and pedagogy. Join colleagues as they discuss new models of learning, present case studies in their disciplines, and explore relevant topics including instructional design standards, technology and student learning, and more.

- Technology and pedagogy
- Instructional design standards
- Technology and student learning
- Student assessment practices
- Teaching studio courses online
- Student technology assistants
- Teaching in new technology environments
- Interactive teaching modules
- Automating feedback to students
- Online student/faculty communications
- Online course content resources
- Curriculum redesign

HOW TO SUBMIT A PROPOSAL

Interested parties are invited to submit proposals via e-mail per the following instructions. All relevant proposals will be considered. The final date for submission is January 12, 2004. Notifications of acceptance will be made by February 1, 2004. Due to a large volume of proposals and multiple submissions, you will receive notification upon receipt and also upon the *acceptance* of your proposed session only.

Please note: As a condition of acceptance, each presenter will be required to submit, by Friday, April 2, 2004, a 1,000- to 1,500-word article for consideration for publication in the conference proceedings on the Syllabus Web site or in ***Syllabus*** magazine.

FULL- AND HALF-DAY WORKSHOPS

(3-6 hours)
Classroom style, in-depth workshops that explore the hows and whys of technology implementation in the subject areas of the tracks.

BREAKOUT SESSIONS

(1-1.5 hours)
Presentations that introduce a technology, program, or pedagogical strategy as well as the issues and benefits of implementation in the higher education environment.

PANEL SESSIONS

(1-1.5 hours)
Plenary sessions with a group of speakers and a moderator brought together for a discussion or debate of topics selected from the conference tracks.

TECHNOLOGY APPLICATION CASE STUDIES

(1-1.5 hours)
These sessions are focused on practical case studies of technology applications and integration in higher education. This is an opportunity for all those involved in IT implementation and operations – faculty, administrators, and technologists – to share their experiences with implementation teams from other campuses. These sessions should be issues/results-focused in line with the conference tracks.

POSTER SESSIONS

A detailed look at graphic presentations and papers posted in designated areas. Poster presenters will be on hand for informal discussion at designated session times.

SUBMISSIONS SHOULD INCLUDE THE FOLLOWING INFORMATION:

I. The title of the presentation
II. The proposed format, e.g., breakout session (see session types, above)
III. An abstract of the presentation content (600 words or less)
IV. An indication of the conference track(s) into which your topic would most likely fall
V. A brief session description suitable for publication (one 75-word paragraph)
VI. Name and academic title (e.g., Ph.D. or Ed.D.) for each presenter
VII. E-mail address and phone number for each presenter (please include both home and office phone numbers)
VIII. Presenter bio(s) suitable for publication (one 75-word paragraph each – be sure to include current position and affiliation)
IX. Any further information that might be helpful in determining the relevance of your topic to the conference

SUBMIT YOUR PROPOSAL BY E-MAIL:

Please include the following in the subject line (where "lastname" is the main presenter's last name): **Syllabus2004 – lastname**
E-mail your proposal to: **speaking@syllabus.com**

Presenters whose proposals have been accepted through the Call for Papers are entitled to receive a "speaker" discount.

Thank you for your proposal. For questions pertinent to your submission, please call Jim Turner at (818) 734-1520 x217 or e-mail jturner@101com.com.

The Internet2 Commons:

Supporting Distributed Engineering Collaboration

By Erik C. Hofer and Thomas A. Finholt, University of Michigan
Jerome F. Hajjar, University of Minnesota
Andrei M. Reinhorn, University at Buffalo

In 2001, the National Science Foundation began a new research initiative aimed at scaling up the national capability for conducting cutting-edge earthquake engineering research needed to reduce vulnerability of built environments to seismic events. This initiative, a 15-year program known as the George E. Brown, Jr. Network for Earthquake Engineering Simulation (NEES, nees.org), promises to transform the practice of earthquake engineering by enabling the combination of physical experimentation, computational simulation, data curation, theory formulation and validation, high-performance computing, and education within a single framework.

The emerging national cyber infrastructure is also being leveraged to develop a national collaboratory, called NEESgrid (neesgrid.org, NSF Award CMS-0117853), that will link together 15 NEES equipment sites and allow them to act as a single virtual earthquake engineering laboratory representing a capital investment of more than $80 million. When this system comes online in late 2004, it will represent a significant use of Internet2's Abilene network, which will provide backbone connectivity for the video, data, and control information that will be sent between sites. The development of the system, however, has also benefited from the network and application resources that Internet2 makes available to its 205 member institutions.

Late in 2001, the NEES community faced a communication crisis. The interdisciplinary challenges of constructing the NEES collaboratory, combined with tight production deadlines, dictated a schedule of regular meetings involving participants from each of the diverse NEES elements (i.e., the equipment site awardees, the four sites within the system integration award, the NEES Consortium Development awardees, and NSF program managers). Regular face-to-face meetings were impractical for a group this large and distributed, and phone conferencing was not ideal because of cost, lack of familiarity among the participants, and diversity in experience and training (e.g., computer scientists vs. structural engineers).

Fortunately, key individuals within the NEES community had experience with point-to-point IP-based video conferencing and were further encouraged by large-scale multipoint experiments like the H.323-based Megaconference (www.megaconference.org). As a result of this experience, the NEES community agreed to adopt H.323 video conferencing to support their distributed interaction because of its ease of use, quick deployment time, and its ability to work without major changes in network configurations at the participating institutions. Internet2 provided the multipoint infrastructure for this experiment through the Commons (commons.Internet2.edu), a set of collaborative services offered to Internet2 members.

The first NEES video conference hosted via the Commons, called the "NEES Equipment Site Technical Forum" (ES-TF), was held on January 24, 2002. Since this initial meeting, the ES-TF has grown to become an important part of the NEES community, with an average of two to four conferences per month. Topics have included data models, telepresence systems, control protocols, experimental setups and new testing methods. Service offerings have expanded considerably beyond the initial data and video conferencing and now include multipoint video conferencing provided by the Internet2 Commons, Placeware Web conferencing, video streaming and archiving through a Starbak Torrent VCG, and asynchronous e-mail discussion and data sharing using the University of Michigan WorkTools environment and custom environments built on the CompreHensive collaborativE Framework (CHEF: www.chefproject.org). These tools and services constitute the collaboration infrastructure that has allowed for the frequent and open discussion of many topics in the NEES collaboration and has produced increased familiarity and understanding among the diverse members of the NEES community.

Throughout the birth and growth of the ES-TF, Internet2 has played a vital enabling role. At a very basic level, Internet2's Abilene network has provided the high bandwidth and low latency connections between sites that made this kind of distributed real-time meeting possible at a low cost to the end users. The Internet2 Commons has similarly played an important role in allowing the community to experiment with collaborative technologies before making major investments and providing capabilities that individual universities are unable to provide. Internet2 promises to play a large role in enabling scientific discovery and improving engineering once NEES comes online, but has played an equally important role by enabling the advanced collaborative services to support the construction of NEES.

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Promoting Internet2 at Teaching Institutions

How one school brought Internet2 to teaching faculty and students

By Franz J. Kurfess, California Polytechnic State University-San Luis Obispo

When Cal Poly-SLO joined the Internet2 consortium in 2001, it established a group of Internet2 champions-faculty representatives from each of the colleges, as well as from the Information Technology Services (ITS) team (http://www.i2.calpoly.edu/). The I2 champions met on a regular basis, and conducted activities like presentations at department meetings, brown bag lunches, and explorations of opportunities for specific disciplines and interests. That group started what continues to be a culture of support for faculty use of Internet2 at Cal Poly.

With help from Cal Poly's Graduate and Research Office and ITS, some mini-grants were awarded in Spring and Summer 2003 to projects proposed by members of the Cal Poly community (See sidebar). The amount of money awarded was relatively small (a few thousand dollars), but enough to enable the investigators to buy some specific networking equipment, and mainly to pay students to work on the project. A second round is underway for the current academic year.

Outreach and Internet2 @ Cal Poly Class

During the Spring 2003 quarter, we conducted a seminar-style class on the Internet2, which included guest speakers from Cal Poly, CENIC, the Internet2 consortium, and a field excursion to the CENIC member meeting in Santa Barbara. This class provided an opportunity for students (and other interested parties) to get familiar with topics related to Internet2, while at the same time utilizing the Internet2 infrastructure in the class. A video documentary on "Internet2@CalPoly," produced by computer science students Jordan Small and Aaron Peckham, is available via streaming from http://mediaserver.calpoly.edu/Engineering/Computer_Science_Department/fkurfess/.

The students in the Internet2 class clearly enjoyed the opportunity to be in close contact with people directly involved in Internet2 and related efforts. Together with the students working on the projects funded by mini-grants, there is a sizable group of students who already have raised the awareness of a considerable number of their peers. One of our unstated intentions was to get students to encourage more faculty to examine the capabilities provided via Internet2. Some faculty members have indeed requested further information, leading to some additional project proposals for the current round of mini-grants.

Our outreach effort through the Internet2 champions so far has been a reasonable success. Since there are no incentives for the champions in the form of financial support or release time, any activities effectively are performed in addition to their regular duties. The most successful activities were individual contacts with people who are working in areas or on projects that can utilize high-bandwidth networking.

Overall, our efforts to promote the use of Internet2 at an institution with a strong focus on teaching has been a success. Considering the limitations in resources like time and funding, the establishment of a group of Internet2 champions, the mini-grants for utilizing Internet2 capabilities, and the Internet2 class allowed us to reach a substantial portion of faculty, staff, and students.

INTERNET2 MINI-GRANT EXAMPLES

I2-Based Remote Viewing System
(Fred DePiero, Electrical Engineering)

Internet2 @ Cal Poly Video Documentary
(Franz Kurfess, Jordan Small, Aaron Peckham, all from Computer Science)

Collaborative Research in Embedded Microprocessor Design
(Diana Keen, Computer Engineering)

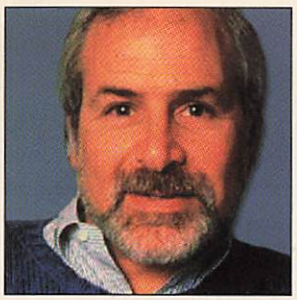
End-to-End Network Performance Testing
(Hugh Smith, Computer Science)

Lumiere Ghosting & CompuPresence Zoetrope Project
(David Gillette, English; Enrica Lovaglio, Arts & Design)

VLSI Design and Test with Internet2-Based Tools
(William Ahlgren, Electrical Engineering)

Internet2 Map Server for GIS
(Walt Bremer, Architecture)

Franz J. Kurfess (fkurfess@csc.calpoly.edu) is an associate professor in the Department of Computer Science at the California Polytechnic State University-San Luis Obispo.



Kenneth C. Green

DIGITAL TWEED

Curricular Reform, Conspiracy, and Philanthropy

Curriculum reform is no small undertaking. The process involves time, people, significant resources, and lots of good will. Assessment is also important, as are leadership and money.

A little over a decade ago the National Science Foundation launched an ambitious effort to reform undergraduate engineering education. The grant competition was constructed in a way that no single university could get any of the millions of dollars NSF had allocated for this project. Rather, the project specs required collaborative efforts. Institutions formed partnerships, initially to develop the proposals and, if funded by NSF, to work on developing a "new" curriculum for undergraduate engineering education.

Of course, given institutional and departmental egos, the partnership process was complex. For example, the rational observer might think that regional consortia—Big Ten campuses or universities in New England—could have found a way to collaborate on these projects. In theory California institutions—the University of California campuses, along with Caltech, the Cal State institutions, and USC—would have made an ideal consortium and could have prepared a very competitive proposal.

One would think. The final proposals reflected complex institutional alliances that crossed regions and time zones. The California universities aligned themselves with institutions elsewhere in the country: UC-Berkeley, UCLA, and USC were each involved in separate proposals.

I got to watch some of this up close and personal, as my research at the time included work on the talent pipeline in science and engineering. However, my research has moved in other directions over the past decade, so I don't know what happened with the NSF undergraduate engineering projects. Given the millions that NSF and the winning bidders were going to spend on these initiatives, I would like to think these projects led to significant change.

The NSF undergraduate engineering initiative comes to mind in the context of MIT's OpenCourseWare (OCW) initiative (www.ocw.mit.edu). Launched with much fanfare in 2001 during the waning months of the dot com era, OCW reflects MIT's thoughtful decision to pursue a different path. Then (as now) other institutions (and institutional officials) saw fortune in online education. MIT's assessment was different: the public story is that after much study (and lots of courting from potential corporate partners) MIT officials were not convinced that there really was a pot of gold at the end of the rainbow of online education.

Illustrated by Michael Trinsey

The OCW announcement, almost three years ago, was open for easy inference. MIT officials insisted that the university was not offering online courses to students; rather, MIT faculty were putting their course materials—syllabi and supporting resources—on the Web for others to use. In other words, one could see the syllabus and review some of the course materials, but not take the class.

And not just a few classes. OCW's announced goal is to make the complete MIT curriculum—everything in the undergraduate and graduate curriculum, across all fields, totalling some 2000 courses—available over the next few years. Speaking at the November 2003 EDUCAUSE Conference, Anne Margulies, executive director of the OCW project, announced that MIT has made significant progress towards this goal: as of fall 2003, the resources for some 500 MIT courses had been posted on the Web.

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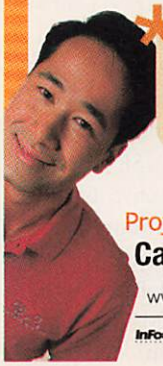

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I'll confess that like many, I was not sure what to make of the initial OCW announcement. It was clear that MIT was not offering courses or certification, just course outlines and some course content. MIT officials seemed adamant that the OCW audience was not students.

So let's assume (or at least infer) that OCW's target audience is really faculty. If so, why all the public fuss about what some observers have tagged as MIT's $100 million investment in OCW?

After all, many faculty have willingly shared syllabi and course materials with their colleagues at other institutions. More recently, some professors have used the Internet to review (and even poach) course outlines and supporting content posted on the Web. On the other hand, do faculty at Caltech, Ohio State, or Purdue really want or need MIT's version of introductory or advanced courses casting a public shadow over their own syllabi?

However, a conversation on a recent trip to Australia helped me see OCW in a new context. Faculty at several universities in Australia told me that prospective students in selected science and engineering majors are now asking if these programs use the MIT curriculum. Interestingly, the queries have been addressed to professors at some of the "Sandstone" institutions (Australia's oldest and elite universities, their version of the Ivy league).

So now, following the conversations in Australia, I began to wonder: Is OCW a carefully-crafted curriculum conspiracy—MIT's effort to drive and dominate science and engineering curricula across the globe? By opting not to offer online courses, has MIT found a smarter, better, more creative way to protect and expand its "brand" against other universities, in the US and elsewhere, offering online courses, certificates, and degrees? Will "teaching the MIT curriculum" become a new measure of implied or inferred program quality? Will *U.S. News and World Report* begin to rate science and engineering programs on the effective implementation of MIT courses and the MIT cirriculum?

Admittedly, these are whimsical and rhetorical questions. MIT's $100 million investment in OCW far surpasses the money NSF allocated for the undergraduate engineering initiative a decade ago. But assisted by a clear vision and hopefully unburdened by the politics and process of faculty committees, OCW may have far greater reach and impact than many past and current NSF curricular initiatives, particularly in developing nations.

Indeed, is it too much hyperbole to think that MIT's OCW initiative will be a catalyst for curricular reform in science and engineering education, in the US and elsewhere? Maybe so.

Is there a risk that OCW could foster a homogenized curriculum? Possibly. Time will tell.

And what happens when money begins to matter? Content, supported by infrastructure, is king on the Internet. OCW provides infrastructure for the content of MIT courses. What happens when the data begin to reveal demand, and demand curves provide a way to extrapolate dollars?

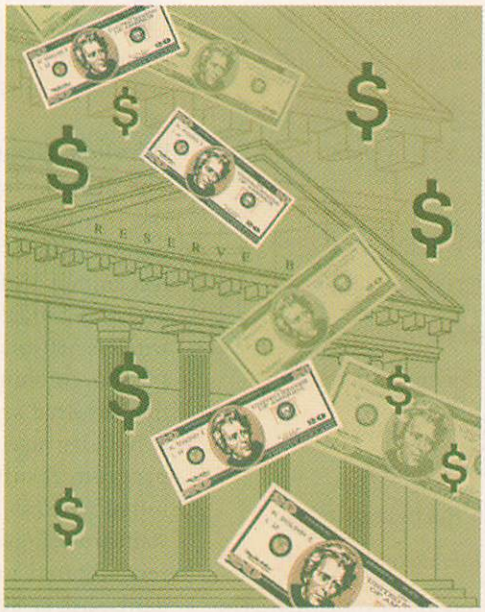
All interesting questions. But in the interim, credit MIT for choosing the road not taken. In her presentation at the 2003 EDUCAUSE Conference (available as a video archive www.educause.edu/conference/annual/2003/resources.asp), Anne Margulies described OCW as intellectual philanthropy—MIT's gift to higher education across the globe. In the poet's words, that road not taken—opting for intellectual philanthropy over potential profit—may make all the difference.

Casey Green (cgreen@campuscomputing.net) *is founding director of The Campus Computing Project (www.campuscomputing.net), a visiting scholar at The Claremont Graduate University and a visiting professor at Case Western Reserve University.*

Sally M. Johnstone

DISTANCE LEARNING

Out with Old, in with New ... Funding Policies



Even though 2003 saw budget cuts in higher education in many states, it also brought some good news for those of us dealing with distance learning. It seems that the policy makers in the U.S. are beginning to recognize the importance of distance learning to allow greater access for students and as potential ways for institutions to share resources.

There are several areas where changes to federal, state, and institutional policies could make a real difference in distance learning availability and practices. Many of the policy areas relate to institutional practices, for example, differential pricing for distance and on-campus learners. This occurs, in part, because distance learning programs frequently must be fully self-supporting. In other words, the student pays all the costs for each course, there is no subsidy as is typically the case for face-to-face classes.

This practice arose because at many campuses, distance learning courses and programs developed in the continuing education program area, and that is the way continuing education works. This type of pricing may be fine for some students but not for others. We can not expect any policy to change without cause. Sometimes the causes for change come from outside the institution.

Even though distance learning is supposed to open up access, one frequently sited barrier for potential students is the difficulty in obtaining financial aid. In 1992 Congress said that if more than 50 percent of an institution's courses or students were technology-mediated distance learning, then the courses were defined as correspondence study. That meant the institutions could not offer students federal financial aid, which is by far the most important source for grants and loans. This summer, bills were introduced in both the House of Representatives and the Senate to change this rule and open up federal funding to more distance learning students. At this point in time, there is no absolute agreement on the parameters, but it does look likely that next year when Higher Education Reauthorization goes through Congress, distance learning will fare well.

Last August another group of policymakers paid some real attention to distance learning. The Western Governors' Association passed a policy resolution entitled *Online Learning Courseware Sharing Standards.* This resolution says in part that the Western Governors believe universities, colleges, and K-12 schools must be able to share electronic academic resources. In order to do that there needs to be standards that course material developers use, but there also needs to be incentives for faculty to use the shared materials. One way to encourage this resource sharing is to build incentives into the financial models that states use to fund public colleges and universities. The policy makers in a state would need a common vision and that would require a nexus of gubernatorial, legislative, and higher education leadership. The governors have signed on in at least 18 western states.

These rather small policy changes can have a major impact on how and who an instructor is likely to teach in the coming years. Let's hope this distance learning-friendly policy trend continues.

Sally Johnstone (sjohnstone@wiche.edu) *is founding director of the Western Cooperative for Educational Telecommunications (WCET) and serves on advisory groups for state, national, and international organizations to help plan and evaluate eLearning projects.*

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University of Pittsburgh ▪ By Jinx P. Walton

Wireless Networking

The University of Pittsburgh's 9,600 employees, including 3,800 faculty members, serve more than 32,000 students through the programs of 18 undergraduate, graduate, and professional schools.

Wireless Networking Pilot

The demand for wireless network access at the University of Pittsburgh has increased dramatically over the past several years. In recognition of the need for increased network access and to keep pace with rapidly evolving wireless network technology, the University of Pittsburgh launched a pilot project in 2001 that involved several selected classrooms and a heavily used student area. The pilot program resulted in the decision to base initial wireless service on the IEEE 802.11b standard using equipment that could easily be reconfigured to operate under newer standards such as 802.11a or 802.11g—as support for these were incorporated into commercially-available equipment.

Central Directory Service

The University of Pittsburgh's Central Directory Service (CDS) includes information on all individuals affiliated with the university. CDS provides the cornerstone for the university's authentication systems. Because the role of each individual is maintained within CDS, the infrastructure for wireless user authorization was already in place.

Bluesocket offered a major advantage for our wireless implementation in that only a Web browser, not client software, is needed to access the customizable user login screen. It is completely compatible with the University of Pittsburgh's LDAP authentication service and provides the ability to restrict or allow access based upon the user's role within CDS. Bluesocket is compatible with all of the popular operating systems (Windows, Windows CE, Linux, and Macintosh) and supports multiple security protocols including IPSec, Point-to-Point Tunneling Protocol (PPTP), and Advanced Encryption Standard (AES). Bluesocket allows for roaming, even when using IPSec. Automatic failover is also supported. Finally, Bluesocket supports RADIUS user accounting allowing the University of Pittsburgh to keep user access logs by using the RADIUS accounting services already in place.

Wireless PittNet

Authenticated wireless network access is available to students in various high-traffic locations on the Pittsburgh campus, including study areas in several academic buildings, the main library, and the student union lounge. Outdoor wireless access is available in selected areas. Faculty and students can connect to the wireless network in designated classrooms. The university departments have the option to implement wireless network access in administrative offices.

Site surveys include consultation with the department to learn and understand its planned use of wireless technology, monitoring of existing radio frequency signals for interference, measurement, evaluation of signal strength, and delivery of a report that describes the proposed layout of the wireless network.

Bluesocket WG-2000 gateways are used to authenticate and authorize users in student areas. WG-1000 gateways are used in departments and classrooms. The University of Pittsburgh supports four wireless network interface cards: Cisco Aironet 340/350 cards, the Orinoco Gold card, the Enterasys RoamAbout, and the Apple AirPort card. All cards must be Wi-Fi compliant and support 128-bit WEP encryption.

Future Direction of Wireless PittNet

The University of Pittsburgh's goal is to offer secure, reliable wireless network service for the benefit of the university community. The University of Pittsburgh will continue to meet or exceed industry standards for security and performance to ensure that this goal is met.

Jinx P. Walton (jpw@pitt.edu) is the director of Computing Services and Systems Development at the University of Pittsburgh.

University of North Carolina-Chapel Hill ▪ By Chris Colomb

Time for Change: Collaboration for Improved Communication, Productivity

Consistently ranked among the top public universities in the United States, the University of North Carolina at Chapel Hill offers its 26,000 students academic programs that span more than 100 disciplines. Coordinating the administration of a university of this size and stature is a monumental task.

Like many higher education institutions, the University of North Carolina at Chapel Hill is challenged to continually improve operational efficiency across campus. The university consistently looks to the promise of new technologies—to streamline processes and elevate the productivity of its staff and faculty.

Recently, the university identified an opportunity to use technology innovation to improve its scheduling capability. We did not have an integrated, standardized electronic system for scheduling appointments within and across departments. Faculty and staff relied on paper calendars, personal digital assistants, and a variety of disparate software systems to manage their schedules. As such, scheduling even the simplest meeting between departments was often a time-consuming and labor-intensive process.

The university decided to implement an integrated calendar solution that would elevate productivity and allow individuals from different departments to easily access each other's calendars to schedule meetings and events.

To solve our scheduling challenge, we examined several vendor solutions and looked at developing our own internal solution. We determined that the "build" strategy would require extensive financial and skill resources and would be a time-consuming process. It would clearly not be the best use of the university's resources. Instead, we focused on finding the vendor solution that would best meet the university's needs.

To achieve the goals of streamlined scheduling capabilities, improved efficiency and cost savings, the university required a solution that would:

- Simplify and consolidate existing systems.
- Provide access campus-wide to faculty and staff regardless of platform.
- Provide high security for sensitive scheduling information.
- Prove to be highly reliable and scalable.

An additional consideration was the selection of a vendor that would offer long-term stability.

We installed the Oracle Calendar, part of the Oracle Collaboration Suite, in August 2002 and today have more than 5,000 users from every department of the institution. Staff and faculty users can easily access the system through Microsoft Outlook, the Web and wireless connections, saving coordination time and boosting productivity.

In addition to scheduling meetings and tracking schedules, faculty and staff are using the system's alert feature to remind them of appointments. Users now receive scheduling reminders via a range of platforms, from e-mail reminders to alerts received via personal scheduling devices. The solution makes it hard to miss an appointment.

The system has also proven itself to be highly available and reliable. With a large number of departments using the system—and a limited number of IT staff to support the system—reliability was an important factor in the university's decision. As important, the solution is secure and has the capability to scale to a large number of users.

The new calendaring system quickly became engrained into everyday life at the University of North Carolina Chapel Hill, and has literally, changed the way we work. Staff members from different departments can easily schedule meetings and access each other's calendars—something we were not able to do before. The university has had widespread acceptance of the system at all levels of the organization—from the executive staff to the administrative team. With the integrated calendar system, the chancellor's office can see departmental calendars, greatly improving visibility and communication throughout the university.

> "The university consistently looks to the promise of new technology—to streamline processes and elevate the productivity of its staff and faculty."

Moving forward, the university plans to roll out Oracle Calendar to its 26,000 students. This next phase will integrate all students, faculty and staff on one calendar system for the first time, taking productivity and communication to an even higher level.

Chris Colomb (chris@email.unc.edu) is manager of Messaging Systems, University of North Carolina at Chapel Hill.

Temple University ▪ By Ariel Silverstone

Managing the Network Security Challenge

For university information technology departments, a balancing act can be challenging. University computer networks are an essential component of university operations. Yet, they are often large, heterogeneous, open, and used by thousands of individuals whose computing habits and expertise are largely unknown.

At Temple University, for example, approximately 16,000 systems—from mainframes and mid-ranges to PCs and laptop devices—connect to a hybrid wired and wireless network. Individual schools and colleges within the university own many of the systems. Students own the remaining connected PCs, laptops, and tablets. Temple University has a diverse user community, ranging from students with no computer experience to professors who teach Computer Science. Consequently, protecting a customer base with such a wide span of expertise poses its own set of challenges from both a technological and an educational perspective.

Add to the complexities of delivering an open, yet secure, computing environment, even as new and increasingly sophisticated forms of malicious computer code are being launched every day, and the obstacles appear insurmountable. At Temple University, the individual ability of departments to do research and teach is tied directly to security—especially to virus protection. In fact, left unchecked by anti-virus software, one of today's fast-spreading threats could shut down an entire network.

As a result, Temple University set out to determine how to maintain a desired level of security across such a varied network and user landscape.

User Awareness

The first priority toward maintaining the appropriate balance between security and freedom was to educate users on security risks. Students, faculty, and staff needed to understand how viruses threatened their computing infrastructure, what they could do to reduce this risk, and how they would benefit from having a more secure network.

To that end, the Temple University launched an awareness campaign. Through frequent e-mail flashes, brochures, and online articles, users learned what viruses were, their effects, and how to prevent them.

And how have students responded? Out of 6,500 residence hall students, only two were reluctant to take part in the Temple University's anti-virus program. One was already using a solution from home, while the other was unacquainted with anti-virus of any type.

Security Choices

Temple University also determined that universities generally have three technology-related options in addressing the network security issue. First, they can simply hope students and other users purchase and install their own security software. Second, they can secure the network but leave the security of individual machines up to the colleges or individuals who own them. Third, they can provide every client system with a security solution that is centrally managed and coordinated. Temple University chose the third option—with measurable success.

Temple University's anti-virus software puts virus protection at the workstation and server tiers of the network. University IT personnel can manage individual users as well as groups of users and can make sure all systems are up-to-date and configured correctly. Symantec Anti-virus leverages the vendor's automated virus submission and response mechanisms to quickly detect, analyze, and repair viruses. The software makes it easy for IT administrators to enforce anti-virus policies across the multi-platform environment.

With a managed anti-virus solution in place, Temple University has been able to side-step many of the recent virus and worm outbreaks that have plagued other institutions.

> "Threats to the security of computer networks will continue to expose students, faculty, and staff to malicious code that can disrupt operations..."

Technology & Awareness

Information technology and the Internet will maintain a vital role in the environment for learning. Threats to the security of computer networks will continue to expose students, faculty, and staff to malicious code that can disrupt operations and impede education.

Managed security solutions, together with user awareness, offer an effective defense against virus threats. At Temple University, this combination of technology and education helps ensure that the IT infrastructure remains a powerful enabling force in encouraging academic freedom without risking online safety.

Ariel Silverstone (arielsilverstone@hotmail.com) is the chief of information security for Temple University.

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University of Rochester ▪ By Ron Dow

Network Printing: Managing Costs

How can we better serve our students? Regardless of factors including size, program offerings, location, and student mission, when it comes down to it, we all share this as a common goal.

At the University of Rochester, changing and improving the processes in technology is one way we are accomplishing this. By closely observing the work practices of our students and listening to their concerns, along with the help from the Information Technology Services of River Campus, we have not only identified new opportunities to put better technology processes in place, but also save money.

It was evident that the printing process in the University of Rochester's main library, accessible to all 4,440 students, needed to be changed. Mountainous paper piles on the printers, long queues, and long lines to use the equipment were among student and staff headaches. Frequent intervention from library staff was often needed to keep up with tasks such as loading paper and changing toner—taking their assistance away from the students.

In addition to the student inconvenience, we began to realize how costly this was. Approximately $20,000 a month was spent just on paper, equipment maintenance, replacement purchases, toner, and supplies. At that time, our students had unlimited access to printers. This generated excessive waste and in many cases, students didn't realize how many documents they were printing at one time. We estimated more than 400,000 pages were printed monthly and almost a third of these documents leaving the library printers were either discarded immediately in an overflowing recycling bin or not even retrieved.

Networked System Brings Efficiency to Library Printing

The chaotic nature of our library printing processes needed to be improved. We tapped the business consultants from Xerox Global Services to work directly with us to analyze the problem and they created a solution to improve the overall library print service.

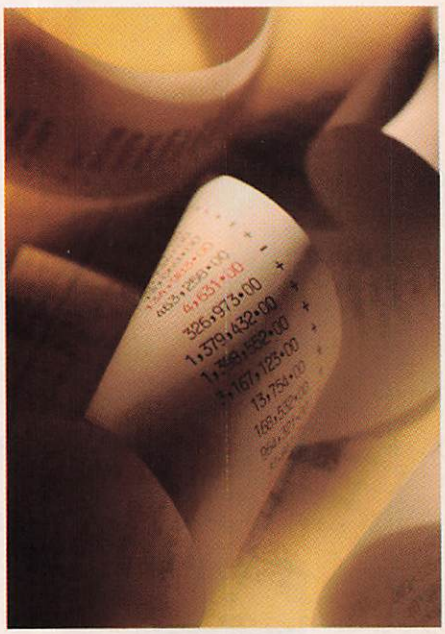
After assessing student habits in the library environment, Xerox Global Services implemented a networked technology system called Student Access Management. Student Access Management is a combination of services and software called Uniprint from Xerox's business partner, Pharos Systems. The system enables our students to print to any location in the library via an ID card system. Students instruct computers to print and then the computers indicate where the documents can be retrieved.

> "As a result, the students are now more conscious of what they print—waste has been significantly reduced, and the system finances itself."

The university places a designated sum of money on the ID card each semester and charges are automatically deducted when students exceed this balance. As a result, the students are now more conscious of what they print—waste has been significantly reduced, and the system finances itself. Additionally, Xerox offers technical support to monitor and ensure the library equipment is operating smoothly.

A Satisfied Student Community

The voice of each student is considered when making any new IT decisions at the University of Rochester. After listening to their concerns associated with long lines at the printers and inconveniences with previous processes, we were able to offer an alternative. The Student Access Management solution has reduced waste, lowered cost, and now provides an easier and faster method for printing student documents. With Student Access Management, librarians at the University of Rochester can focus on their must crucial role—helping to educate and promote a positive learning environment.



Ron Dow (rdow@library.rochester.edu) is dean of libraries at the University of Rochester.

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FEATURED PRODUCT ■ VIDIUS PORTAUTHORITY

PortAuthority: Attacking the Inside-Job

Do you know where your campus security breaches are? Most IT professionals who deal with security spend their time and budgets preventing intrusion from the outside: viruses, worms, hackers, and thieves. By some estimates, more than 85 percent of security spending is devoted to resisting outside attacks. In fact, it is more than likely that some of the security violations are coming from inside, through the deliberate or inadvertent release of vital information to unauthorized sources.

Campuses have much to protect: student records, intellectual property, personnel information, and more. It is easy to imagine scenarios where data could be revealed—accidentally or on purpose—to the wrong parties. How can an academic institution keep this vital data inside its walls?

One approach would be to install a product called PortAuthority from Beverly Hills-based Vidius. PortAuthority is a software solution that relies on "electronic fingerprinting" technology to detect and quarantine any internal or outbound security breach. The software analyzes outbound communication, examining how the actual information is constructed within a given document or message, and then assesses the information for a violation, using over two dozen sophisticated algorithms. According to Kevin Moylan, vice president of product marketing for Vidius, PortAuthority is the only product of its kind. "Without a doubt," says Moylan, "we can positively identify particular portions of confidential information either in whole or in part. We provide the ability to identify it, to quarantine it, and to notify the appropriate parties about the breach. All of this occurs in real time."

Vidius describes PortAuthority as far more reliable than key word filtering (which can generate a lot of false positives) and encryption (depending on user discretion and works only at the file level, not the information level).

No client-side encryption or viewing software is necessary with PortAuthority. The software protects entire data sets or documents as well as portions or bits of data, including any that have been modified, cut, copied, and pasted into other files or messages. PortAuthority blocks the outgoing message, preventing it from being distributed either internally or externally, and the system administrator receives instant notification.

Vidius's Web site statistics (from Richard Hunter of Gartner), that "more than 70 percent of unauthorized access to information systems are committed by employees, as are more than 95 percent of intrusions that result in significant financial losses." This statistic, of course, does not necessarily include academic scenarios. No data is available on the amount of unauthorized outgoing e-mail on campus. However, colleges and universities are in a unique, and uniquely vulnerable position, in that hundreds or thousands of new users come onto the system each year. Plus, academia's commitment to free speech and the free dissemination of ideas make it even more difficult to exert control over data.

PortAuthority is configurable to meet the needs of particular campuses. Administrators can designate which directory to

monitor. Only designated information is inspected. A block override function assigns specific personnel as "power users," granting them the ability to release blocked messages. A comprehensive reporting feature tracks repeat offenders and policy violations. It also analyzes threats to determine whether they are probably accidental or intentional. And its broad file support feature supports over 250 native file formats, including Word, Excel, and other common formats. The software is scalable and permits clustered server environments.

For more information about ***PortAuthority****, contact Vidius, Beverly Hills, CA; (310) 888-2330; www.vidius.com.*

EDUCATOR'S REVIEW ■ TED ROBERGE, UNIVERSITY OF CALIFORNIA-IRVINE

Packetshaper: A Lifesaver in the Peer-to-Peer Storms

The University of California-Irvine, houses about 6,700 residents, spread across four undergraduate, two graduate/family, and two visiting professor housing complexes. The housing department is responsible for the complete network that provides services to all residents, including the high-speed gigabit-speed backbone, servers that manage the network, and almost 500 pieces of Cisco network equipment.

The first notable Peer-to-Peer program to rear its head across the Internet was Napster, which was quickly followed by an onslaught of dozens of more advanced and aggressive file sharing programs. As these programs began to proliferate, networks of all kinds (business, government, and educational) began to suffer dramatically.

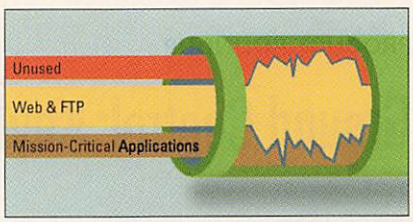
In the university environment, file-sharing programs were taking over all available bandwidth and educational uses of the network were suffering. Research, data transfers, Web surfing, e-mail, and management systems were performing dismally. P-to-P programs were using up every bit of bandwidth that we had available. We would increase the bandwidth, then P-to-P would gobble it up. Regardless of how much bandwidth we bought, it became evident that it would never be enough.

We needed to find a solution that would balance the traditional open environment of educational uses of the Internet, and the recreational demands of the students. After evaluating several methods of managing our bandwidth, we settled on two network management systems, PacketShapers; the 8500/ISP models—currently evaluating the latest 9500/ISP model. This product, manufactured by Packeteer of Cupertino, California, has proven to be the best solution for meeting our needs.

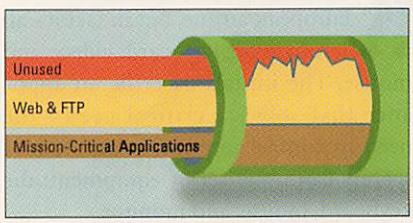
PacketShapers now allow us to fully manage our bandwidth. We now know what applications are flowing across the network, when before we were unsure. Once we installed PacketShaper and let it "discover" what was on the network, we were aghast to find out that 60 percent to 70 percent of the Internet traffic we were paying for was P-to-P. Files were streaming into and out of the university at an incredible rate: music, the latest release of full-length movies, videos, television shows and series, pirated software, and the list goes on. By using PacketShaper to actually classify and identify what was on our network, we were then able to begin controlling it.

Now we use features of PacketShaper to prioritize applications. Residents need fast Web browsing, so we are able to give it a high priority. Files and connections that come from or are destined for the academic sides of the campus are also given high priority. A high priority is also given to online gaming, as it does not consume much bandwidth but requires fast response. And finally, we are able to identify most P-to-P applications and limit total bandwidth so the aggressive programs do not adversely affect the performance of the network.

The PacketShapers is an excellent addition to our suite of management tools. The graphic interface is clean and easy to use. Further incorporated into the equipment are superb reporting functions. Data can be extracted and displayed as graphs. We can select time or date ranges, top users, percentages of use, and do this down to each application, user, or function.



BEFORE PACKETSHAPER



AFTER PACKETSHAPER

Furthermore, we are able to switch over to the less friendly "command line interface," and drill down through the data to an incredibly detailed degree. We do this quite often as we classify viruses, worms, and Trojan Horses such as the MSBlaster or Nachi outbreak. We are also able to get extremely granular with the analysis of each user's traffic flow and to identify infections and take remedial action.

PacketShaper, although being a lifesaver for us, is not without its drawbacks. There are sometimes problems

with the Web page interface loading slowly. This can be frustrating at times when trying to diagnose problems on the network. Further, the Command Line Interface tends to be a bit cumbersome at times, and finding the correct syntax for commands needs to be improved. However, as with any equipment that uses Command Lines, the more one uses it, the easier it becomes. We also find that online gamers tend to experience the dreaded "lag"—or periodic slowdowns of response times.

However, it should be noted that our experience working with Packeteer's engineers and developers is another feature of the product that has been superb. The working relationships we have developed with Packeteer enhance our use of their equipment. Should an unknown application develop, degrading the performance of the network, the developers and engineers are always eager to help identify the problem so it can be managed.

It should be remembered that a PacketShaper is not, nor was it designed to be, a full-featured firewall. We look at the PacketShaper as complementary to all other network management tools. By having a PacketShaper in our "tool box," our network can be kept up and operating at peak performance full time. Without it, the educational uses of our network would be dismal.

Ted Roberge (troberge@uci.edu) is manager for Residential Network Services at the University of California-Irvine.

PRODUCT ROUNDUP

Ground Control: Keyboard-Video-Mouse Switches

KVM may sound like the name of a European airline, but in fact it's an acronym for keyboard, video, and mouse. The initials describe an appliance that solves a critical need—the need to control multiple computers or servers from one set of equipment: the keyboard, mouse, and monitor.

Networking has fueled the growth of this industry, since it has freed KVM switches from the tether of a short cable, allowing one switch to control whole banks of servers from a distance, whether that occurs locally or remotely. KVM over IP (the common description for the technology and also a trademark of Avocent Corporation) has given back valuable real estate to server farms by allowing administrators to run the whole lot without attaching the peripherals to each computer. We've surveyed some of the biggest manufacturers in this market to find out about their current offerings.

Altusen KVM on the Net

Altusen's KVM on the Net is an IP implemented device that allows network administrators to access computers from any station connected to the network, whether it is the LAN, WAN, or the World Wide Web. Network administrators can remotely perform routine

maintenance, BIOS level troubleshooting, restart the system, install software, and run applications. Since KVM on the NET uses TCP/IP as its communication protocol, network administrators can remotely access attached KVM switches, allowing remote control of the attached servers to perform many tasks with ease and speed. It supports 10Base-T, 100Base-T, TCP/IP, and HTTP through the Java Client. Advanced security encryption, password protection, sophisticated user filters and user management, stealth mode, and automatic lockout ensure that remote access is secure. Also, KVM on the NET offers high resolution (up to 1280 x 1024), user-friendly Windows GUI Client Software, and Java client software.

*Contact: **Altusen**, Irvine, CA; (888) 999-2836; www.altusen.com/products/*

American Megatrends MegaRAC K1

American Megatrends (AMI) recently released its MegaRAC K1 product, which attaches directly to the back of a PC,

Look Ma, No Wires

It's about time that someone applied KVM technology to the world of wireless. Avocent's LongView Wireless KVM switcher lets a user connect a computer to a keyboard, mouse, and monitor (VGA, SVGA, or XGA) from up to 100 feet away. Video compression and protocol technology support the transmission of 24-bit color at 30 frames/second.

Based on 802.11a and Advanced Encryption Standard (AES), LongView connects directly to target devices and serves as the radio interface link so that the computer can transmit secure audio and high-resolution video data through walls with no cables. The plug-and-play product requires no new operating system, application software, or drivers. The new wireless technology has the capability to simplify maintenance and provide a new level of flexibility in configuring computers and monitors.

server (or analog KVM) for non-intrusive and instantaneous remote management. The zero-U, standalone digital solution does not take up vital rack or desktop space. It is available in DVI or VGA versions. The ability to attach to an existing analog KVM switch enables users to convert an analog KVM to KVM over IP; thus the purchase becomes more of an upgrade than replacement of equipment. Users can manage a server remotely from the Web, control multiple servers using one MegaRAC K1 by attaching to a multi-port analog switch, and display multiple views.

Contact: ***American Megatrends****, Norcross, GA; (770) 246-8600; www.ami.com.*

Avocent DS Series

Avocent introduced the world's first digital KVM over IP solution four years ago in response to new requirements for secure server access. Avocent's current KVM over IP product line includes more than ten different appliances that provide local or remote access and control of not only servers but almost any device in the data center.

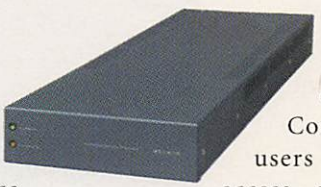
Avocent's DS Series lets users remotely control not only local servers, but routers or power devices that are located across campus or in other remote locations, using a browser or client interface. From a single-user, eight-port device to an eight-user eight-port device, Avocent has the field covered. DS1800 offers access to an unlimited number of servers or devices. The DSR4010 combines digital and analog access in a 16-port KVM switch, providing simultaneous access for up to four users, three or four of whom may be remote.

The feature-rich DS Series of network appliances simplifies access and control with DSView, allowing users convenient access to all data center devices—all from a single screen. Avocent's DSView provides integrated, secure Click and Connect control to any connected device, using IP connections. The latest version of DSView includes enhanced security features and administration benefits, including detailed audit logs, SNMP traps, and integrated power management.

Contact: ***Avocent****, Huntsville, AL; 866-286-2368; www.avocent.com.*

Belkin OmniView Enterprise Series Remote IP Console

The OmniView Console is compatible with both KVM and power switches and sets up simply. It uses 128-bit SSL encryption that prevents unauthorized access and is flash-upgradeable to keep current with most recent servers and devices. The Console allows users to remotely access a server or multiple servers connected to a KVM switch over a TCP/IP network. It is accessible through a standard Web browser and works with Microsoft Internet Explorer 5.5 or above. Flash-upgrades firmware is included for optimal functionality. The Console is designed to be a compact solution; it includes cabling as part of the package.



Contact: ***Belkin Corporation****, Compton, CA; (310) 898-1100; www.belkin.com.*

Digital V6 Kaveman 16

Kaveman16, from Digital V6, is a remote access network management device that enables an administrator to remotely control up to 16 servers at one time via one local keyboard, mouse, and monitor. Servers can be controlled remotely or locally and multiple users can connect to the same system and access it from anywhere at anytime via IP. Kaveman 16 allows up to six simultaneous and independent users to access and manage the attached servers as well as power cycle any connected device. In addition, Kaveman offers specialized security features including Stealth and Turtle modes. The Stealth mode prevents port scans and other network probes. The product's Turtle mode disables itself and shuts down when attacked to prevent hackers from continuously trying to break in.

Contact ***Digital V6****, Markham, Ontario, Canada; (866) 922-2333; www.digitalv6.com.*

Raritan Dominion KSX

The Dominion KSX is the industry's first integrated offering that enables the user to use a standard Web browser to access and manage the multi-platform IT equipment typically located in remote offices. The KSX enables IT staff to manage all the equipment that is typically found in the equipment closets of remote offices as if they were physically present. The KSX integrates Raritan's key technologies, including remote KVM access and control over IP, remote serial console control, and remote power control, in a single, easy-to-use appliance.

Also from Raritan is the IP-Reach M-Series. With its intuitive navigation and lightning-fast mouse synchronization, IP-Reach provides companies secure 128-bit-SSL Web access to any KVM switch, including Raritan's award-winning Paragon, Z-Series, and Master-Console switches. IP-Reach combines the benefits of security, fast performance, tight mouse synchronization, and easy accessibility from a Web browser. IP-Reach provides BIOS-level access to servers and is hardware agnostic—it supports Raritan's KVM switches, as well as other vendors' switches.

Contact: ***Raritan Computer****, Somerset, NJ; (800) 724-8090; www.raritan.com.*

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Trends, *continued from page 7*

JSR-168 portlet specification that allows information and services to be personalized and customized by the viewer; and local interface that a given institution can customize to their campus preferred look and feel.

A Partners Program will support developers at other institutions to help them utilize the resources, development tools, and framework of SAKAI.

This is a novel effort trying to get true collaborative investment to build a common code base that will provide open source educational tools to anyone who wants them. Will it work? It's too early to say but the institutions in the core group have made substantial fiscal and operational commitments toward this effort.

The immediate educational pay-off is an enterprise-scale course management system, distributed research collaboration tools, and a portal to which to use them. A good deal more depends on you and your colleagues, participating, trying the tools, and developing your own following this lead.

Windows Services in Heterogeneous Environments

Many of us are struggling to find ways of supporting the variety of computers, which students and institutions acquire to do their work. Ninety percent or more of the computers run MS Windows. You would think that it would make this job a little easier, but it doesn't. The differentiation that vendors seek to promote to distinguish their computer from the 'others' makes their support a nightmare.

One solution brings us full circle. Instead of providing the software for installation on individual machines, provide access to the application. That is what the Citrix MetaFrame Presentation Server does. Citrix has been around a long time (since 1989) providing what is referred to as a "thin client." A small client runs on the local machine that connects it to a server where the Windows application executes. It's not a cheap solution but it does have its benefits.

One of the attributes of Citrix is the ability to lengthen the lifespan of the client. You can use an old PC and still run the latest software since it's executing on the MetaFrame server. The Citrix client runs on a wide variety of PCs, both desktops and laptops. This enables you to run an application reliably on a wide variety of PCs.

Another advantage is running Windows applications from Mac platforms. It would be nice if there is comparable applications for the Mac to those we run on the PC. The reality is that there are critical applications you run on Windows for which there are no Macintosh alternatives. That can be more than annoying if you have to run the application to do your core business.

You can run Virtual PC but you'll need a fast Macintosh with a lot of memory—the application may still not run fast enough to be useful on a day-in/day-out basis. I wish it weren't the case, but that's the current reality.

You can, however, run a Citrix thin client on your Mac and run the Windows application on the MetaFrame server. At some institutions where there is a significant number of installed Apple computers, this has become a standard way to let the user choose the platform of their choice, while allowing them to run the Windows applications they need.

It is not an inexpensive solution. How can you tell if this is a good choice for your needs? We'll do a cost comparison and look at alternatives to running Windows applications for your educational software needs —next time.

Phil Long, Ph.D. *(longpd@mindspring.com) is senior strategist for the Academic Computing Enterprise at MIT. He is also a senior associate for the TLT Group of the AAHE.*

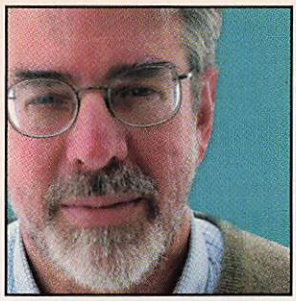
Reflections, *continued from page 42*

To make the Internet inclusive, everyone's ideas must be encouraged. We might disagree with some, but even the strongest objections can be made respectfully. We need to restore civility to the Internet. Tact, courtesy, and graciousness shouldn't be disregarded when you are on the Internet. We all know good table manners. We should insist on good Internet manners.

Of course we need laws against illegal uses of the Internet, and we can expect government agencies to do their part in tracking down and prosecuting the bad folks. But the Internet belongs to all of us, not just the government, and we all must do our part to protect it. We need Internet neighborhood watches. When we see an Internet crime or Internet bad behavior it is our responsibility to not tolerate it, to report it (maybe to the Internet Ghostbusters), to do what we can do as individuals and organizations to prevent it and to bring the baddies to justice. We outnumber the baddies, but they count on our indifference and acquiescence. A crime against anyone on the Internet is a crime against all of us who would use it legally and productively.

Today, we collectively expend a huge amount of time and effort to hold off the spammers, virus writers, smut peddlers, and others that would turn the Internet into the meanest streets of the toughest neighborhoods. It is time to use more of those resources to go on the offensive. Collectively we certainly have the creativity and the resources to outsmart the baddies. All we need is more determination. In the 1976 movie, *Network*, television anchor Howard Beal gets his viewers to adopt the mantra, "We're mad as hell and we aren't going to take it anymore!" The baddies should be put on notice. It is *our* Internet and we are not going to take their expropriation of it anymore.

Howard Strauss (howard@princeton.edu) *is the manager of technology outreach at Princeton University.*



Howard Strauss

REFLECTIONS

ANOTHER LOOK AT EDUCATION TECHNOLOGY

A Plexus of Evil

We rely upon many networks to bring us the fruits of modern civilization; water, phone, electricity, the cable and broadcast networks, and of course the Internet. While none of these networks are essential for our survival—a few people live in rugged isolation without any of them—they help make our lives fuller, more productive, and more enjoyable. The networks are not without their costs. For example, the water we use creates sewage, electric power plants pollute, TV and radio towers scar the landscape, and the Internet adds one more expense to our already burdened schools. All of these networks also present some dangers. Electricity starts fires and electrocutes unsuspecting people. Public water systems can get contaminated and spread disease. TV can make you sedentary and obese. And the Internet has been used to help abduct children. But the benefits of these networks far outweigh the downsides. With proper awareness and regulation one doesn't think twice about turning on a UL approved electric appliance, drinking from a fluoridated water tap (though not while using that electric appliance), surfing TV channels, or paying a bill on the Internet.

But the Internet has been changing. It is in danger of becoming a plexus of evil where no one and no computer is safe. Stephen Baker in the August 25, 2003 issue of *Business Week* says, "the Internet has dark alleyways filled with thieves, hackers, and scamps—and the industry has not found a way to cordon off their mean streets." Of the 42 percent of Americans who are not yet on the Internet, Mr. Baker reports that while the "confounding technology" kept some folks away, "even greater numbers feared barrages of online pornography and attacks by credit-card thieves."

I used to get occasional annoying spam. I now get about 10 spams for each real message and spams find ways to slip past increasingly sophisticated filters. When I put my laptop computer online it only takes seconds before it is attacked; often faster than I can update the patches and virus protection software that might stem the onslaughts. Intellectual property rights are often ignored. Illegal material such as child porn now uses the Internet as its primary conduit. The baddies are taking over, making the Internet an unsafe place for children, a dangerous place to connect your computer to, a place so full of spam, porn, scams, and nasty people that it is not a place you'd even want to visit let alone hang out at all day.

It is our Internet and we—universities, corporations, government, and individuals—must take responsibility for it and make it safe for us and our children. Mr. Baker refers to the Internet "industry." What industry? There is no CEO of the Internet. The Internet industry is us. If we don't collectively take more responsibility for it, it will become increasingly dangerous. Worse yet, the government may make its use so restrictive as to make it unusable as the free and safe marketplace for ideas and services for everyone that it should be.

In taking back the Internet we need to do it with reverence to the First Amendment to the U.S. Constitution, paraphrased here for the Internet: *there shall be no restrictions prohibiting the free exercise of speech, or of the press; or the right of the people peaceably to collaborate, and to exchange information, services, and applications.* Everyone must be free to send anyone any legal thing they want, but everyone must have the absolute right to not see anything they *don't* want to see or hear. Legal things not suitable for children should be allowed on the Web, but parents, schools and others responsible for children must be able to create secure safe havens on the Internet for children—protected much better than today's marginal filters are able to do.

continued on page 41

Illustrated by Peter Lacalamita

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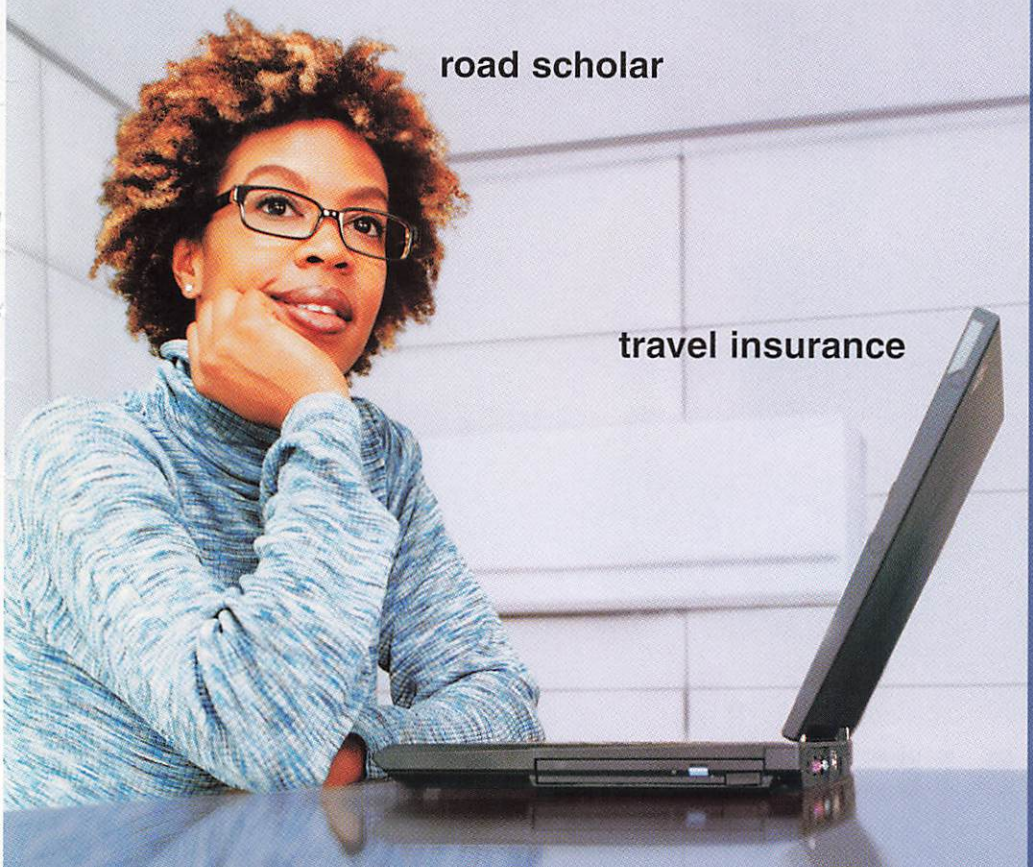

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